IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

AMERICAN PATENTS LLC, Plaintiff, v. MEDIATEK INC., MEDIATEK USA INC., BROADCOM PTE. LTD., BROADCOM CORPORATION, LENOVO (SHANGHAI) ELECTRONICS TECHNOLOGY CO. LTD., LENOVO GROUP, LTD., NXP SEMICONDUCTORS N.V., NXP B.V., NXP USA, INC., QUALCOMM INCORPORATED and QUALCOMM TECHNOLOGIES, INC., Defendants.	CIVIL ACTION NO. 6:18-CV-339 ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT **JURY TRIAL DEMANDED**

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff American Patents LLC ("American Patents" or "Plaintiff") files this original complaint against Defendants MediaTek Inc., MediaTek USA Inc., Broadcom Pte. Ltd., Broadcom Corporation, Lenovo (Shanghai) Electronics Technology Co. Ltd., Lenovo Group, Ltd., NXP Semiconductors N.V., NXP B.V., NXP USA, Inc., Qualcomm Incorporated, and Qualcomm Technologies, Inc. (collectively "Defendants"), alleging, based on its own knowledge as to itself and its own actions and based on information and belief as to all other matters, as follows:

PARTIES

1. American Patents is a limited liability company formed under the laws of the State of Texas, with its principal place of business at 2325 Oak Alley, Tyler, Texas, 75703.

2. MediaTek Inc. is a company incorporated under the laws of Taiwan, having an address of No. 1, Dusing Road 1, Hsinchu Science Park, Hsinchu City 30078, Taiwan.

3. MediaTek USA Inc. is a company incorporated under the laws of the State of Delaware and having an established place of business at 5914 W. Courtyard Drive, Austin, Texas 78730. MediaTek USA is registered to conduct business in Texas and may be served through its registered agent, CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201-3136.

4. The Defendants identified in paragraphs 2 and 3 above (collectively, "MediaTek") are companies which together comprise one of the world's largest manufacturers of integrated circuits.

5. The MediaTek defendants named above are part of the same corporate structure and distribution chain for the making, importing, offering to sell, selling, and/or using of the accused devices in the United States, including in the State of Texas generally and this judicial district in particular.

6. The MediaTek defendants named above share the same management, common ownership, advertising platforms, facilities, distribution chains and platforms, and accused product lines and products involving related technologies.

7. Thus, the MediaTek defendants named above operate as a unitary business venture and are jointly and severally liable for the acts of patent infringement alleged herein.

8. Broadcom Pte. Ltd. is a corporation organized under the laws of the Republic of Singapore. Broadcom Limited has headquarters at 1 Yishun Avenue 7, Singapore 768923.

9. Broadcom Corporation is a corporation organized under the laws of the state of California. Broadcom Corporation can be served with process by serving its registered agent:

Corporation Service Company d/b/a CSC-Lawyers Incorporating Service Company, 211 E. 7th Street, Suite 620, Austin, Texas 78701.

10. The Defendants identified in paragraphs 8 and 9 above (collectively, "Broadcom") are companies which together comprise one of the world's largest manufacturers of integrated circuits.

11. The Broadcom defendants named above are part of the same corporate structure and distribution chain for the making, importing, offering to sell, selling, and/or using of the accused devices in the United States, including in the State of Texas generally and this judicial district in particular.

12. The Broadcom defendants named above share the same management, common ownership, advertising platforms, facilities, distribution chains and platforms, and accused product lines and products involving related technologies.

13. Thus, the Broadcom defendants named above operate as a unitary business venture and are jointly and severally liable for the acts of patent infringement alleged herein.

14. Lenovo (Shanghai) Electronics Technology Co. Ltd. is a company organized under the laws of the People's Republic of China. Lenovo (Shanghai) Electronics Technology Co. Ltd. has an office at No. 68 Building, 199 Fenju Rd., China (Shanghai) Pilot Free Trade Zone, Shanghai, China, 200131.

15. Lenovo Group, Ltd. is a company organized under the laws of the People's Republic of China. Lenovo Group, Ltd. has an office at No. 6 Chuang Ye Road, Haidian District, Beijing, China, 100085.

16. The Defendants identified in paragraphs 14 and 15 above (collectively, "Lenovo") are companies which together comprise one of the world's largest manufacturers of integrated circuits.

17. The Lenovo defendants named above are part of the same corporate structure and distribution chain for the making, importing, offering to sell, selling, and/or using of the accused devices in the United States, including in the State of Texas generally and this judicial district in particular.

18. The Lenovo defendants named above share the same management, common ownership, advertising platforms, facilities, distribution chains and platforms, and accused product lines and products involving related technologies.

19. Thus, the Lenovo defendants named above operate as a unitary business venture and are jointly and severally liable for the acts of patent infringement alleged herein.

20. NXP Semiconductors N.V. is a corporation organized and existing under the laws of the Netherlands, having a place of business at High Tech Campus 60, 5656 AG Eindhoven, the Netherlands.

21. NXP B.V. is a corporation organized and existing under the laws of the Netherlands, having a place of business at High Tech Campus 60, 5656 AG Eindhoven, the Netherlands.

22. NXP USA, Inc. is a corporation organized and existing under the laws of the state of Delaware, having its principal place of business at 6501 William Cannon Drive West, Austin, TX 78735. It can be served via its registered agent: Corporation Service Company d/b/a CSC – Lawyers Inc., 211 E. 7th Street Suite 620, Austin, TX 78701.

23. The Defendants identified in paragraphs 20-22 above (collectively, "NXP") are companies which together comprise one of the world's largest manufacturers of integrated circuits.

24. The NXP defendants named above are part of the same corporate structure and distribution chain for the making, importing, offering to sell, selling, and/or using of the accused devices in the United States, including in the State of Texas generally and this judicial district in particular.

25. The NXP defendants named above share the same management, common ownership, advertising platforms, facilities, distribution chains and platforms, and accused product lines and products involving related technologies.

26. Thus, the NXP defendants named above operate as a unitary business venture and are jointly and severally liable for the acts of patent infringement alleged herein.

27. Qualcomm Incorporated is a Delaware corporation. Qualcomm Incorporated may be served through its registered agent, Prentice Hall Corp. System, 211 E. 7th Street Suite 620, Austin, Texas 78701.

28. Qualcomm Technologies, Inc. is a Delaware corporation. Qualcomm Technologies, Inc. may be served through its registered agent, Corporation Service Company d/b/a CSC-Lawyers Inc., 211 E. 7th Street Suite 620, Austin, Texas 78701.

29. The Defendants identified in paragraphs 27 and 28 above (collectively, "Qualcomm") are companies which together comprise one of the world's largest manufacturers of integrated circuits.

30. The Qualcomm defendants named above are part of the same corporate structure and distribution chain for the making, importing, offering to sell, selling, and/or using of the

accused devices in the United States, including in the State of Texas generally and this judicial district in particular.

31. The Qualcomm defendants named above share the same management, common ownership, advertising platforms, facilities, distribution chains and platforms, and accused product lines and products involving related technologies.

32. Thus, the Qualcomm defendants named above operate as a unitary business venture and are jointly and severally liable for the acts of patent infringement alleged herein.

33. The parties to this action are properly joined under 35 U.S.C. § 299 because the right to relief asserted against Defendants jointly and severally arises out of the same series of transactions or occurrences relating to the making and using of the same products or processes, including products using the processors and related processes based on common ARM architectures. Additionally, questions of fact common to all defendants will arise in this action.

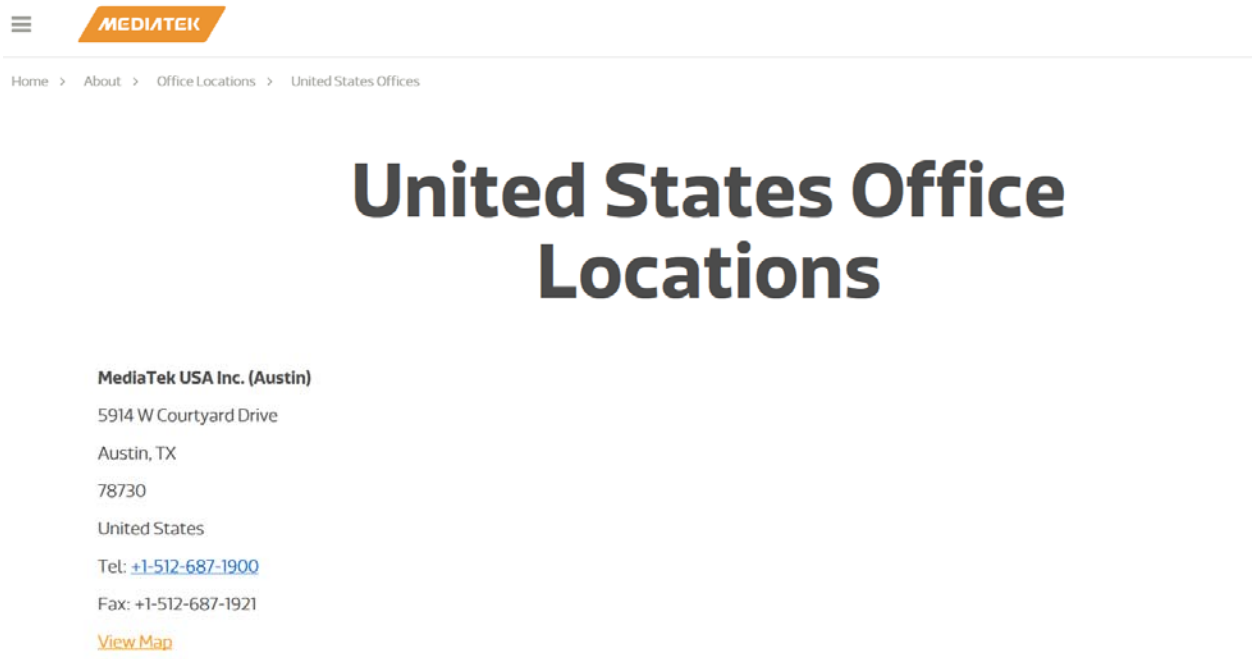
JURISDICTION AND VENUE

34. This is an action for infringement of United States patents arising under 35 U.S.C. §§ 271, 281, and 284–85, among others. This Court has subject matter jurisdiction of the action under 28 U.S.C. § 1331 and § 1338(a).

35. This Court has personal jurisdiction over Defendants pursuant to due process and/or the Texas Long Arm Statute because, *inter alia*, (i) Defendants have done and continue to do business in Texas and (ii) Defendants have committed and continue to commit acts of patent infringement in the State of Texas, including making, using, offering to sell, and/or selling accused products in Texas, and/or importing accused products into Texas, including by Internet sales and sales via retail and wholesale stores, inducing others to commit acts of patent infringement in Texas, and/or committing a least a portion of any other infringements alleged

herein. In addition, or in the alternative, this Court has personal jurisdiction over Defendants pursuant to Fed. R. Civ. P. 4(k)(2).

36. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), and 1400(b) because (i) MediaTek has done and continues to do business in this district; (ii) MediaTek has committed and continues to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by internet sales and sales via retail and wholesale stores, and/or inducing others to commit acts of patent infringement in this district; (iii) MediaTek Inc. is a foreign entity; and (iv) MediaTek USA Inc. has a regular and established place of business in this district at 5914 W. Courtyard Drive, Austin, Texas 78730, as stated on MediaTek's website:



https://www.mediatek.com/about/office-locations/mediatek-usa-offices

37. Venue is proper as to MediaTek Inc., which is organized under the laws of Taiwan. 28 U.S.C. § 1391(c)(3) provides that "a defendant not resident in the United States may

be sued in any judicial district, and the joinder of such a defendant shall be disregarded in determining where the action may be brought with respect to other defendants."

38. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), and 1400(b) because (i) Broadcom has done and continues to do business in this district; (ii) Broadcom has committed and continues to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by internet sales and sales via retail and wholesale stores, and/or inducing others to commit acts of patent infringement in this district; (iii) Broadcom Pte. Ltd. is a foreign entity; and (iv) Broadcom Corporation has regular and established places of business in this district at 2901 Via Fortuna Drive, Suite 400, Floor 4, Terrace 6, Austin, Texas 78746 and 3801 S. Capital of Texas Highway, Barton Creek Plaza II, Suite 150 and 240, Floor 1 and 2, Austin, Texas 78704 as stated on Broadcom's website:

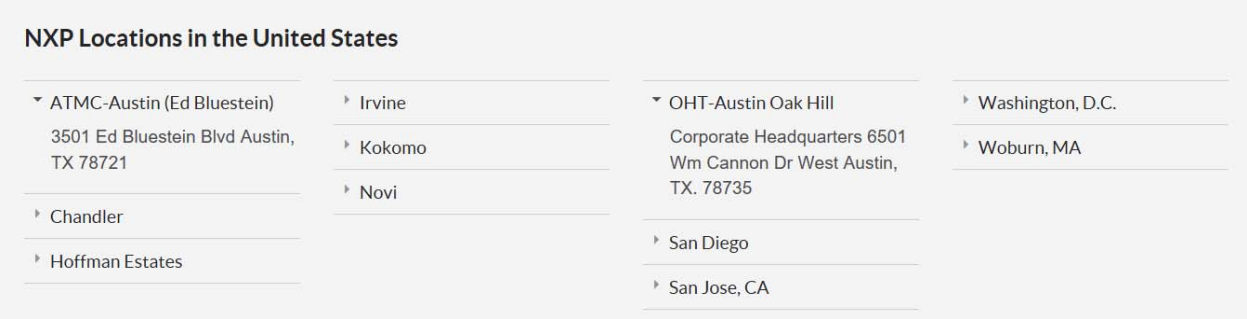
https://www.broadcom.com/company/contact/#locations

39. Venue is proper as to Broadcom Pte. Ltd., which is organized under the laws of the Republic of Singapore. 28 U.S.C. § 1391(c)(3) provides that "a defendant not resident in the United States may be sued in any judicial district, and the joinder of such a defendant shall be disregarded in determining where the action may be brought with respect to other defendants."

40. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), and 1400(b) because (i) Lenovo has done and continues to do business in this district; (ii) Lenovo has committed and continues to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by internet sales and sales via retail and wholesale stores, and/or inducing others to commit acts of patent infringement in this district; and (iii) Lenovo (Shanghai) Electronics Technology Co., Ltd. and Lenovo Group, Ltd. are foreign entities.

41. Venue is proper as to Lenovo (Shanghai) Electronics Technology Co., Ltd. and Lenovo Group, Ltd., which are organized under the laws of the People's Republic of China. 28 U.S.C. § 1391(c)(3) provides that "a defendant not resident in the United States may be sued in any judicial district, and the joinder of such a defendant shall be disregarded in determining where the action may be brought with respect to other defendants."

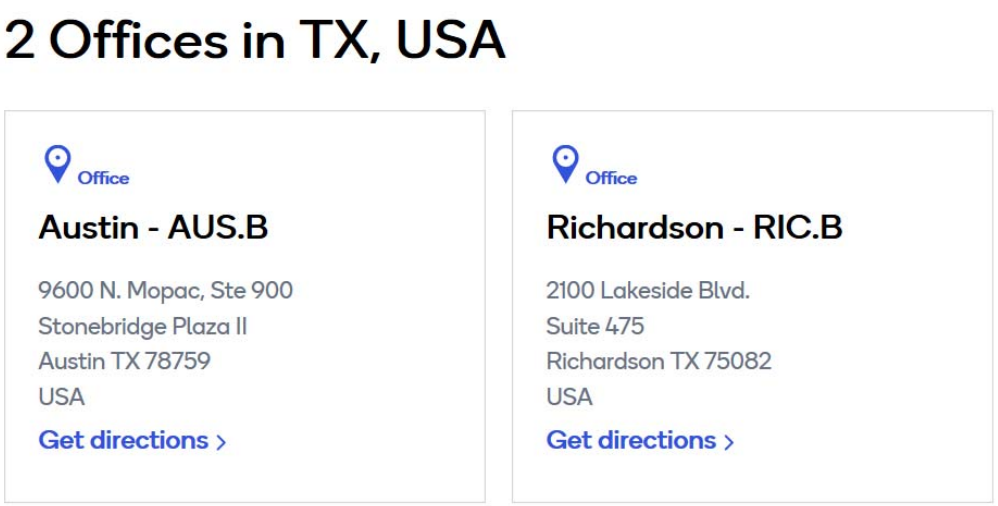
42. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), and 1400(b) because (i) NXP has done and continues to do business in this district; (ii) NXP has committed and continues to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by internet sales and sales via retail and wholesale stores, and/or inducing others to commit acts of patent infringement in this district; (iii) NXP Semiconductors N.V. and NXP B.V. are foreign entities; and (iv) NXP USA, Inc. has a regular and established place of business in this district at 6501 William Cannon Dr. West, Austin, TX 78735, as stated on NXP's website:



https://www.nxp.com/about/about-nxp/about-nxp/worldwide-locations/nxp-in-the-united-states:USA

43. Venue is proper as to NXP Semiconductors N.V. and NXP B.V., which are organized under the laws of the Netherlands. 28 U.S.C. § 1391(c)(3) provides that "a defendant not resident in the United States may be sued in any judicial district, and the joinder of such a defendant shall be disregarded in determining where the action may be brought with respect to other defendants."

44. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), and 1400(b) because (i) Qualcomm has done and continues to do business in this district; (ii) Qualcomm has committed and continues to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by internet sales and sales via retail and wholesale stores, and/or inducing others to commit acts of patent infringement in this district; and (iii) Qualcomm has a regular and established place of business in this district at 9600 N. Mopac, Ste 900, Stonebridge Plaza II, Austin, Texas 78759, as stated on Qualcomm's website:



https://www.qualcomm.com/company/facilities/offices?country=USA&region=TX

BACKGROUND

45. The patents-in-suit generally pertain to on-chip service capabilities used in integrated circuits. The technology disclosed by the patents was developed in the 1990s by employees of On-Chip Technologies, Inc. including: Dr. Bulent Dervisoglu, who received his Ph.D. in Computer Science from the University of Edinburgh; Laurence H. Cooke, who received a bachelor's degree in Applied Mathematics from Stanford University; and Vacit Arat, who received a master's degree in Electrical Engineering from the University of Houston.

46. Prior to the patented technology, testing and debugging integrated circuits was largely directed to the chip level of integrated circuits. These approaches led to higher costs (including sometimes doubled circuitry for testing) and longer time-to-market for integrated circuit products.

47. Then, pioneers such as Dr. Dervisoglu and his colleagues solved these problems when they invented their patented on-chip service and testing that uses embedded testing circuitry within an integrated circuit to provide for custom testing with minimal cost addition and

improved time-to-market. Their ideas were recognized by *Evaluation Engineering* after Dr. Dervisoglu's presentation at the 1999 International Test Conference, and their solution is widely used throughout the industry.

48. After issuance, the validity of one of the patents-in-suit, the '371 Patent, was tested in an inter partes review. In a Final Written Decision, the PTAB ultimately confirmed the validity of claims 2 and 7-10 of the '371 Patent, imposing estoppel on Toshiba Corporation, Toshiba America, Inc., Toshiba America Electronic Components, Inc., and Toshiba America Information Systems, Inc., and their privies, from further challenging the validity of those claims.

COUNT I

DIRECT INFRINGEMENT OF U.S. PATENT NO. 6,964,001

49. On November 8, 2005, United States Patent No. 6,964,001 ("the '001 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "On-Chip Service Processor."

50. American Patents is the owner of the '001 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '001 Patent against infringers, and to collect damages for all relevant times.

51. MediaTek made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its MT6595, Helio X10, and Helio X27 families of products that include advanced on-chip service capabilities ("accused products") [1]:

[1] A non-exhaustive list of additional accused products includes the MT6739, MT6750, MT6752, MT6753, Helio P, Helio A22, MT7622, MT7623, MT8x series (including MT8173, MT8176,

MT6595

The world's first octa-core 4G LTE smartphone chip with the new ARM Cortex-A17 processor

MediaTek MT6795 is a high-performance SoC which satisfies multimedia requirements of even the most demanding users, featuring multimedia subsystems that support many technologies never before possible or seen in a smartphone, including support for 120Hz displays and the capability to create and playback 480 frames per second (fps) 1080p Full HD Super-Slow Motion videos. MT6595 embeds a range of MediaTek technologies, including: MediaTek CorePilot™ heterogeneous multiprocessing technology which unlocks the power of all eight cores for outstanding performance with ultra-low power consumption and thermal control, as well as dual-channel LPDDR3 clocked at 933MHz for top-end memory bandwidth in a smartphone. MediaTek ClearMotion™ technology to eliminate motion jitter and ensure smooth video playback on mobile devices.

Source: https://www.mediatek.com/products/smartphones/mt6595

Processor

CPU Cluster 1:
ARM-A17 @ 2.5GHz

CPU Cluster 2:
ARM-A7 @ 1.7GHz

Source: https://www.mediatek.com/products/smartphones/mt6595

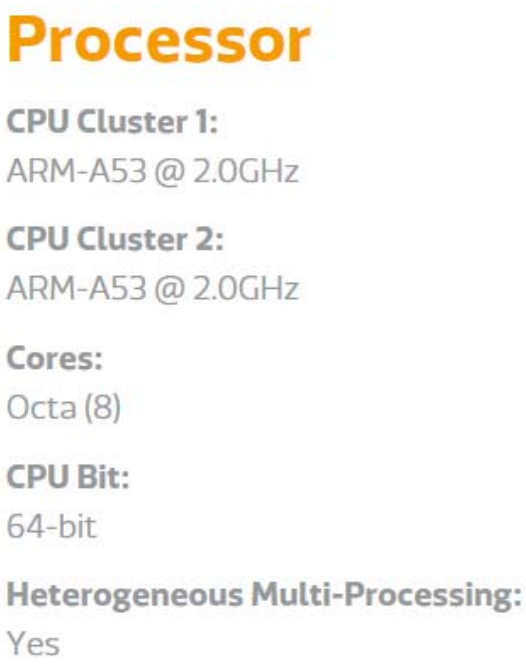
MediaTek Helio X10

64-bit true octa-core SoC with LTE and world's first 2K display support

MediaTek Helio X10 (MT6795) is a high-performance SoC which satisfies multimedia requirements of even the most demanding users, featuring multimedia subsystems that support many technologies never before possible or seen in a smartphone, including support for 120Hz displays and the capability to create and playback 480 frames per second (fps) 1080p Full HD Super-Slow Motion videos. MT6795 embeds a range of MediaTek technologies, including: MediaTek CorePilot™ heterogeneous multiprocessing technology which unlocks the power of all eight cores for outstanding performance with ultra-low power consumption and thermal control, as well as dual-channel LPDDR3 clocked at 933MHz for top-end memory bandwidth in a smartphone. MediaTek ClearMotion™ technology to eliminate motion jitter and ensure smooth video playback on mobile devices.

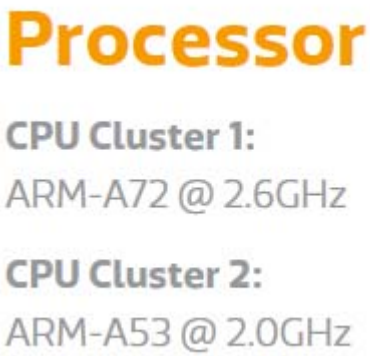
Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10

MT8783, MT8785, and MT8163), and Helio X series (including Helio X20, Helio X23, and Helio X25) families of products that include advanced on-chip service capabilities.



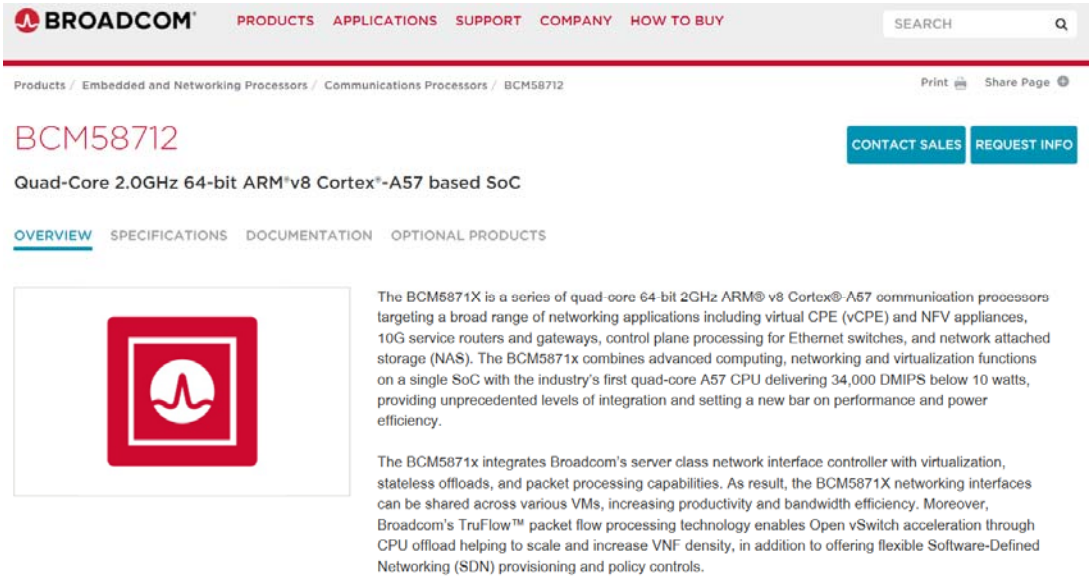
Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10

Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

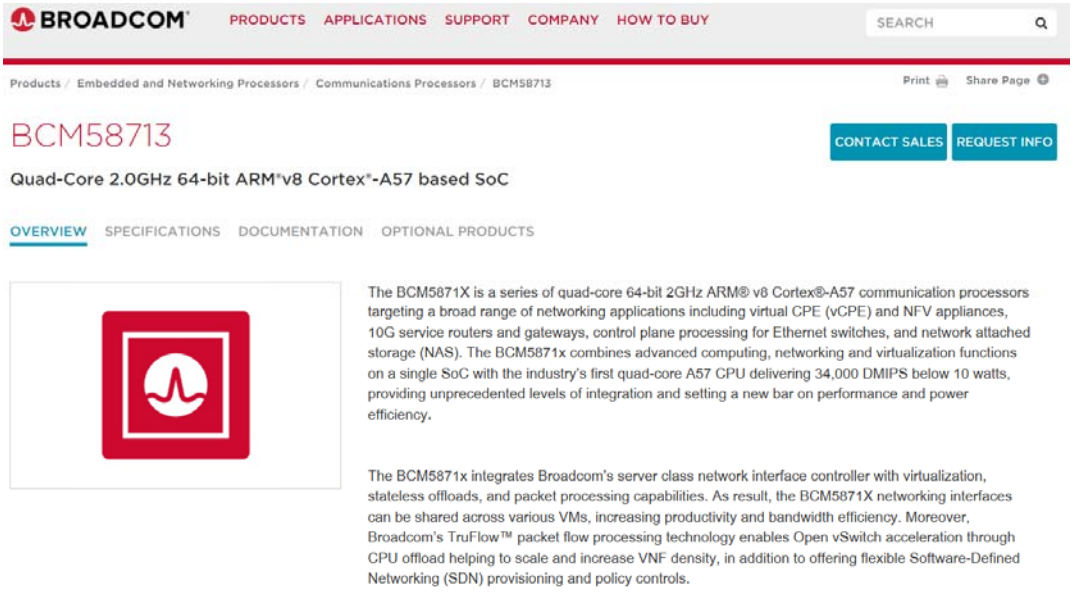


Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

52. Broadcom made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its BCM58712 and BCM58713 families of products that include advanced on-chip service capabilities ("accused products"):

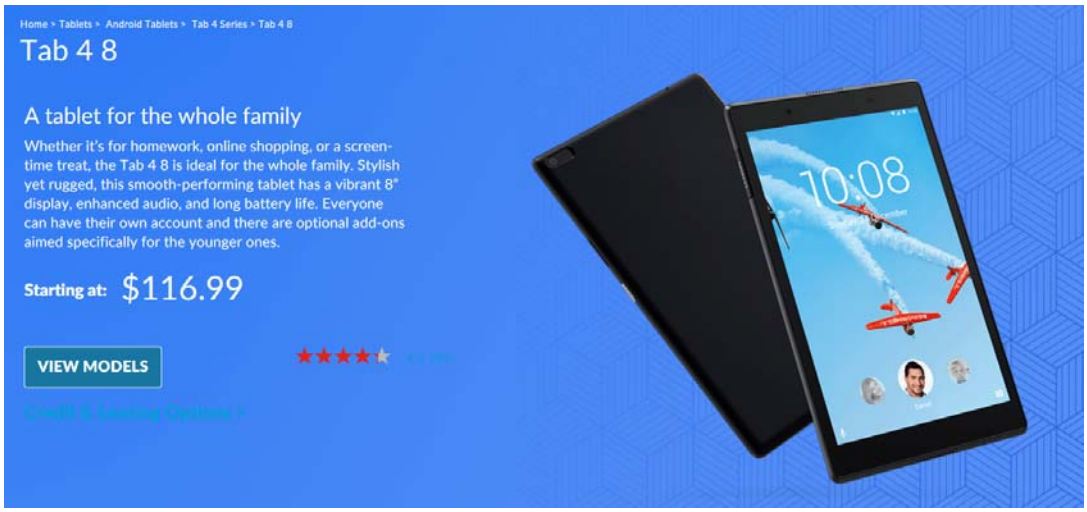


Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58712/



Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58713/

53. Lenovo made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Lenovo Tab 4 8, Lenovo Tab 4 10, and Lenovo Tab 3 10 families of products that include advanced on-chip service capabilities ("accused products"):



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

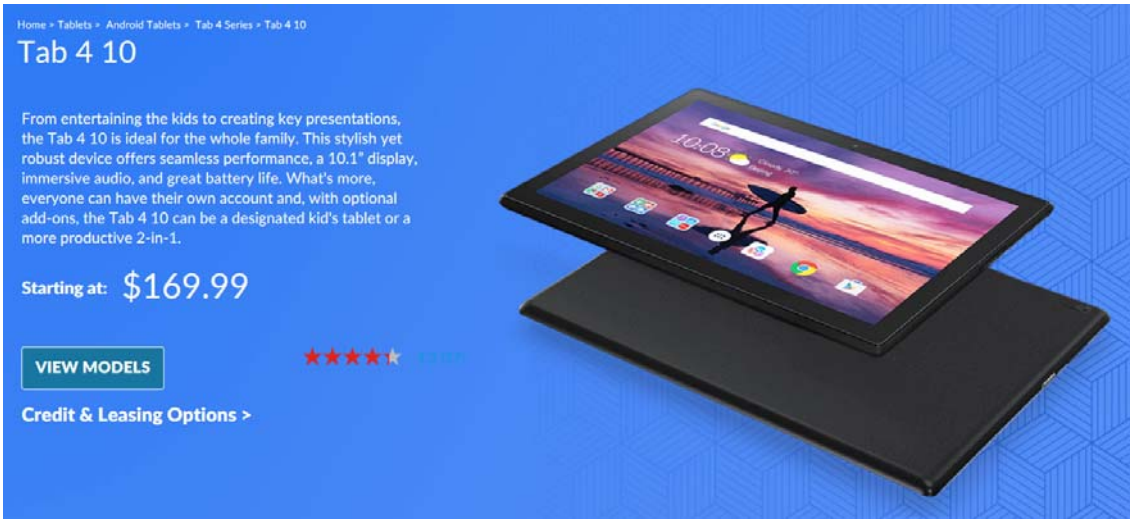
Processor	Qualcomm® Snapdragon™ MSM8917 Processor (1.4 GHz)
Operating System	Android™ Nougat 7.1

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

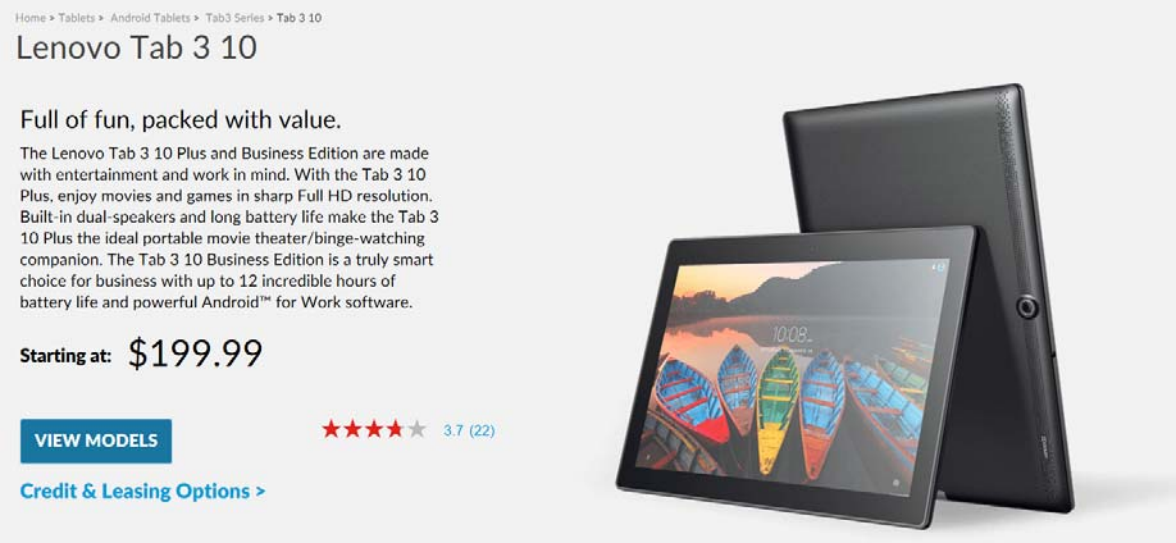
Processor	Qualcomm® Snapdragon™ APQ8017 Processor (1.40GHz)

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

Processor	MediaTek™ 8161 Quad-Core Processor (1.30GHz 1MB)

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

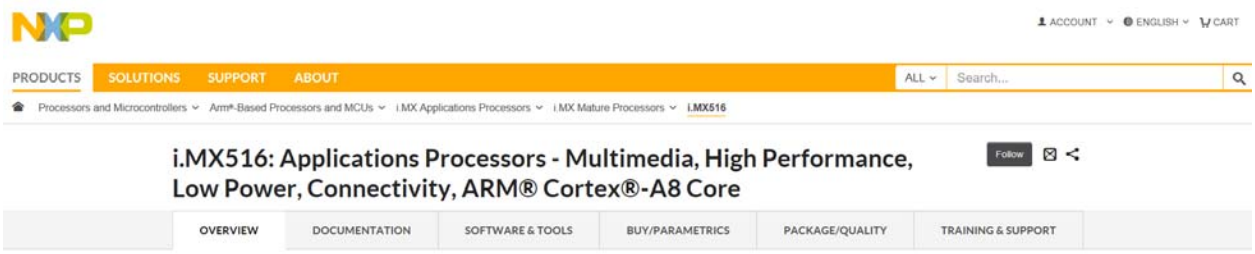
> The MediaTek MT8161 is an ARM based entry-level to mid-range SoC for (Android based) tablets. It offers four ARM Cortex-A53 processor cores (quad-core) that are clocked with up to 1.3 GHz. Furthermore, an ARM Mali-720 graphics card, a LPDDR3 memory controller (e.g., accessing 1 GB in the Lenovo Tab 2 A8-50), Bluetooth 4.0 and dual-band 802.11 b/g/n are integrated in the SoC.

Source: https://www.notebookcheck.net/Mediatek-MT8161-Tablet-SoC.145089.0.html

54. NXP made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its i.MX516, S32V234,

and i.MX 8QuadMax families of products that include advanced on-chip service capabilities

("accused products")[2]:



Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-mature-processors/applications-processors-multimedia-high-performance-low-power-connectivity-arm-cortex-a8-core:i.MX516

Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/s32-automotive-platform/vision-processor-for-front-and-surround-view-camera-machine-learning-and-sensor-fusion-applications:S32V234

[2] A non-exhaustive list of additional accused products includes the i.MX 7 series, i.MX 8 series, i.MX Mature series, QorIQ Layerscape series, i.MX534, i.MX535, i.MX537, i.MX8M, and i.MX 8QuadPlus families of products that include advanced on-chip service capabilities.

Feature	i.MX 8QuadMax	i.MX 8QuadPlus
ARM® Core	2 x ARM Cortex®-A72	1 x Cortex-A72
ARM Core	4 x Cortex-A53	4 x Cortex-A53
ARM Core	2 x Cortex-M4F	2 x Cortex-M4F

Source: fact sheet downloaded from https://www.nxp.com/docs/en/fact-sheet/IMX8FAMFS.pdf

55. Qualcomm made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Snapdragon 410E and Snapdragon 650 families of products that include advanced on-chip service capabilities ("accused products")[3]:

> Designed to meet the demanding requirements of embedded computing applications with its high performance, energy efficiency, multimedia features, integrated connectivity and long-term support, the Qualcomm® Snapdragon™ 410E embedded platform is an ideal platform for the Internet of Things.

Source: https://www.qualcomm.com/products/apq8016e

CPU	CPU Clock Speed: Up to 1.2 GHz CPU Cores: Quad-core CPU, 4x ARM Cortex A53 CPU Bit Architecture: 64-bit, 32-bit

Source: https://www.qualcomm.com/products/apq8016e

[3] A non-exhaustive list of additional accused products includes the Snapdragon 400 tier (including Snapdragon 439 (SDM439), Snapdragon 450, Snapdragon 427 (MSM8920), and Snapdragon 435 (MSM8940)), MSM8956, the Snapdragon 600 tier (including Snapdragon 652 (MSM8976), and Snapdragon 653 (MSM8976 Pro)) families of products that include advanced on-chip service capabilities.

Snapdragon 650 Mobile Platform

The Qualcomm® Snapdragon™ 650 mobile platform supports high-quality, efficient performance, multimedia, gaming and connectivity, thanks to its powerful 64-bit capable hexa-core CPUs, integrated Qualcomm® Snapdragon™ X8 LTE with Cat 7 speeds, Qualcomm® Adreno™ 510 GPU, and support for 4K Ultra HD video.

Source: https://www.qualcomm.com/products/snapdragon/processors/650

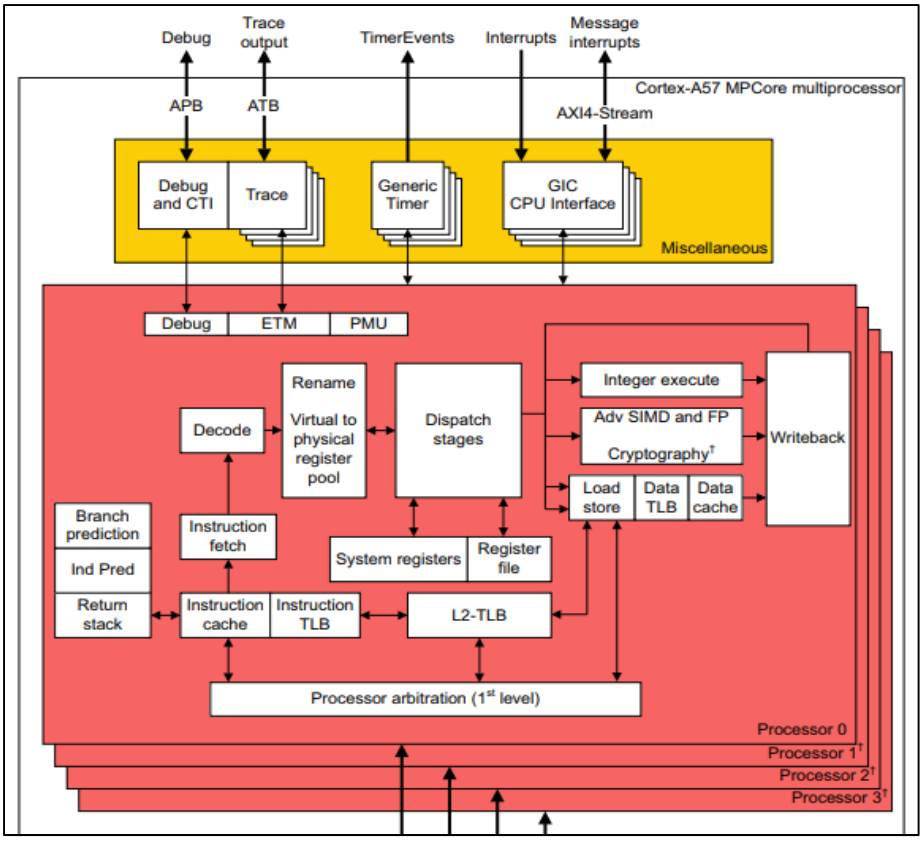
CPU	CPU Clock Speed: Up to 1.8 GHz CPU Cores: Hexa-core CPU, 2x ARM Cortex A72, 4x ARM Cortex A53 CPU Bit Architecture: 64-bit

Source: https://www.qualcomm.com/products/snapdragon/processors/650

56. By doing so, Defendants have directly infringed (literally and/or under the doctrine of equivalents) at least Claim 5 of the '001 Patent. Defendants' infringement in this regard is ongoing.

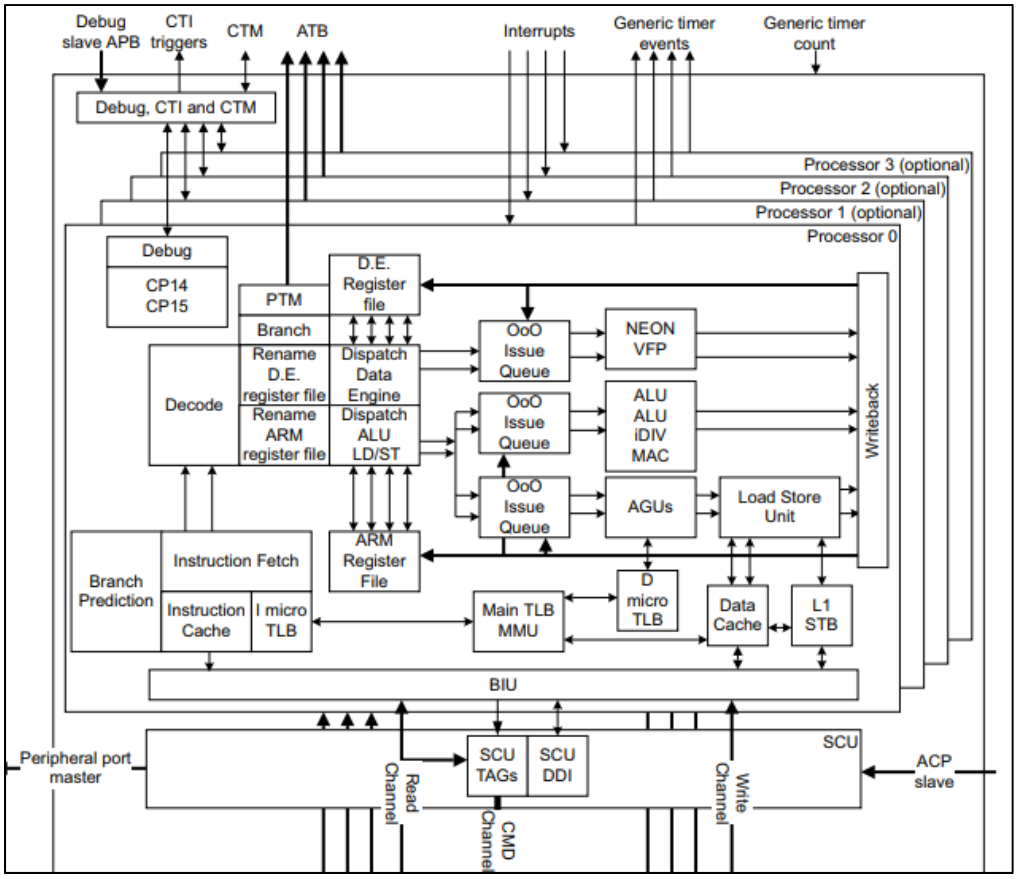
57. Defendants have infringed the '001 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale integrated circuits having advanced on-chip service capabilities.

58. The accused products include a multiplicity of logic blocks.



Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf



Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

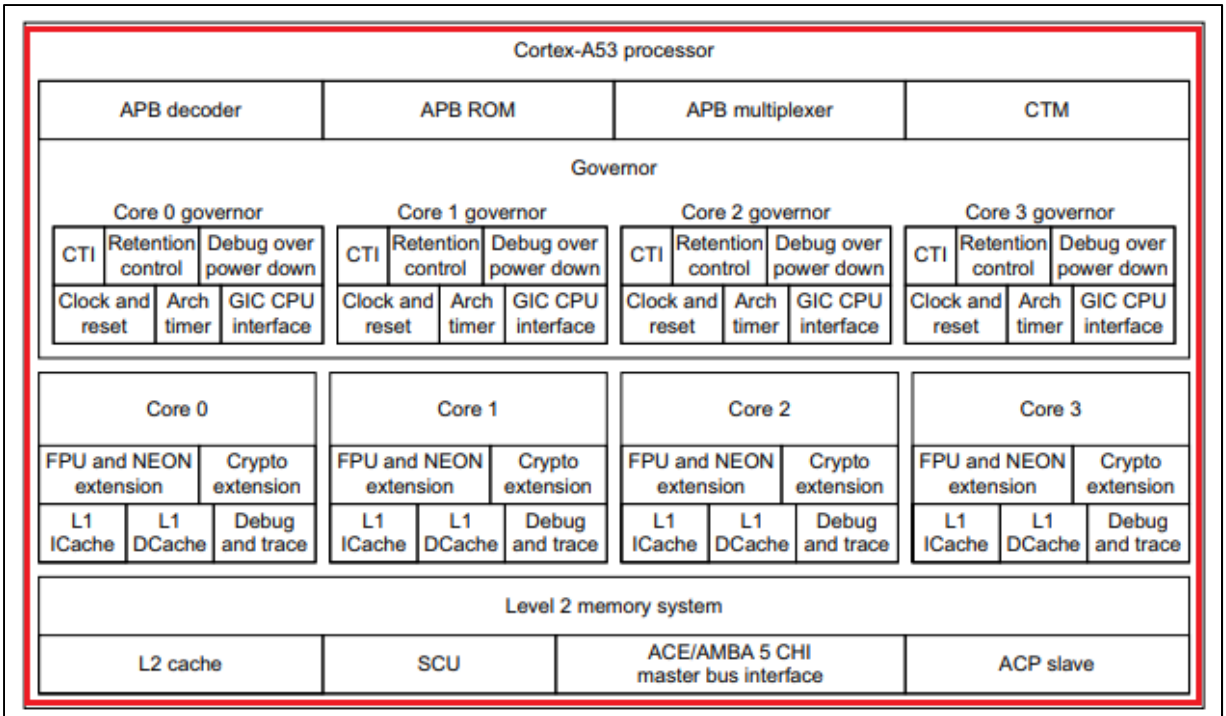
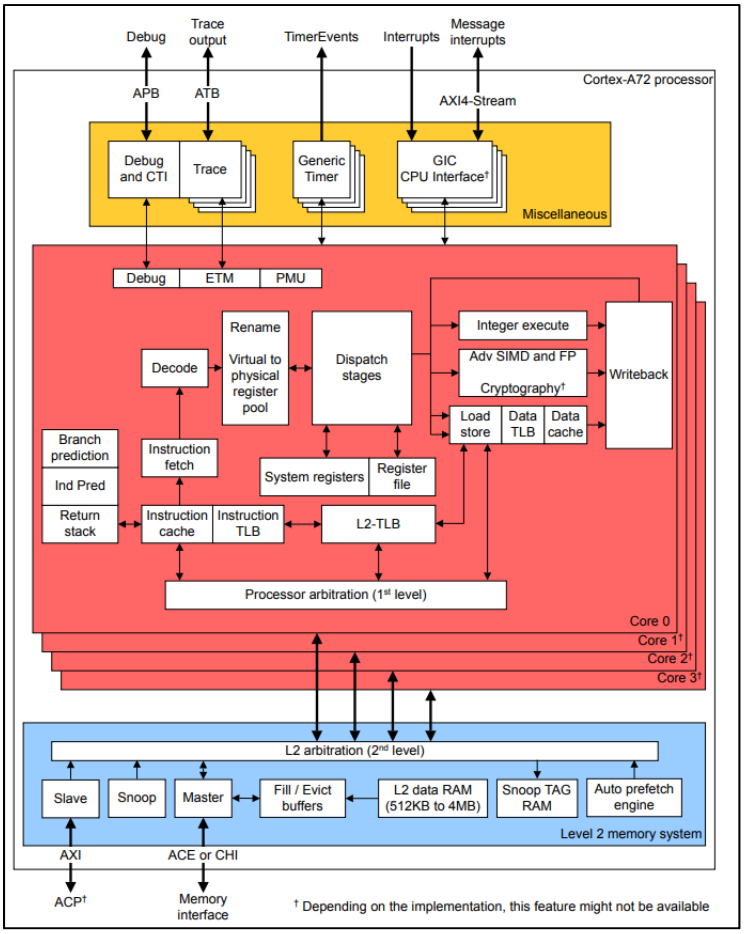


Figure 2-1 Cortex-A53 processor block diagram

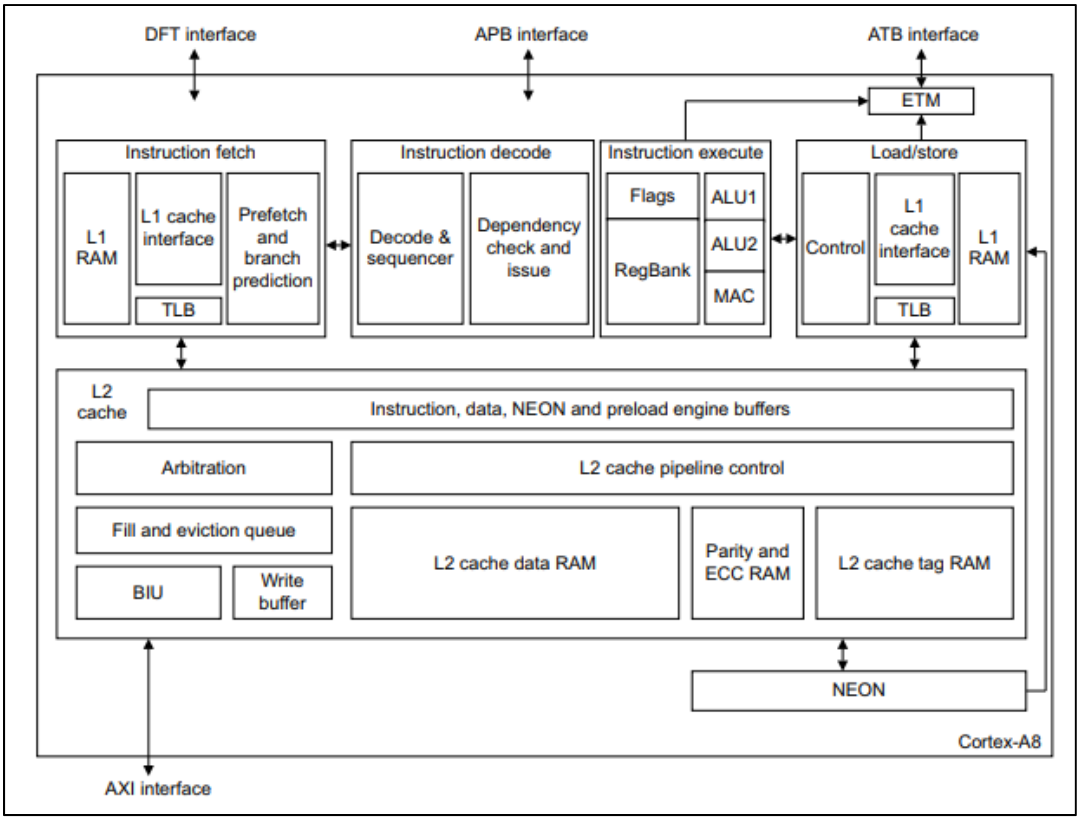
Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf



Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf



Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf

59. The accused products include an on-chip logic analyzer with a multiplicity of input ports.

Embedded Trace Macrocell architecture

The multiprocessor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

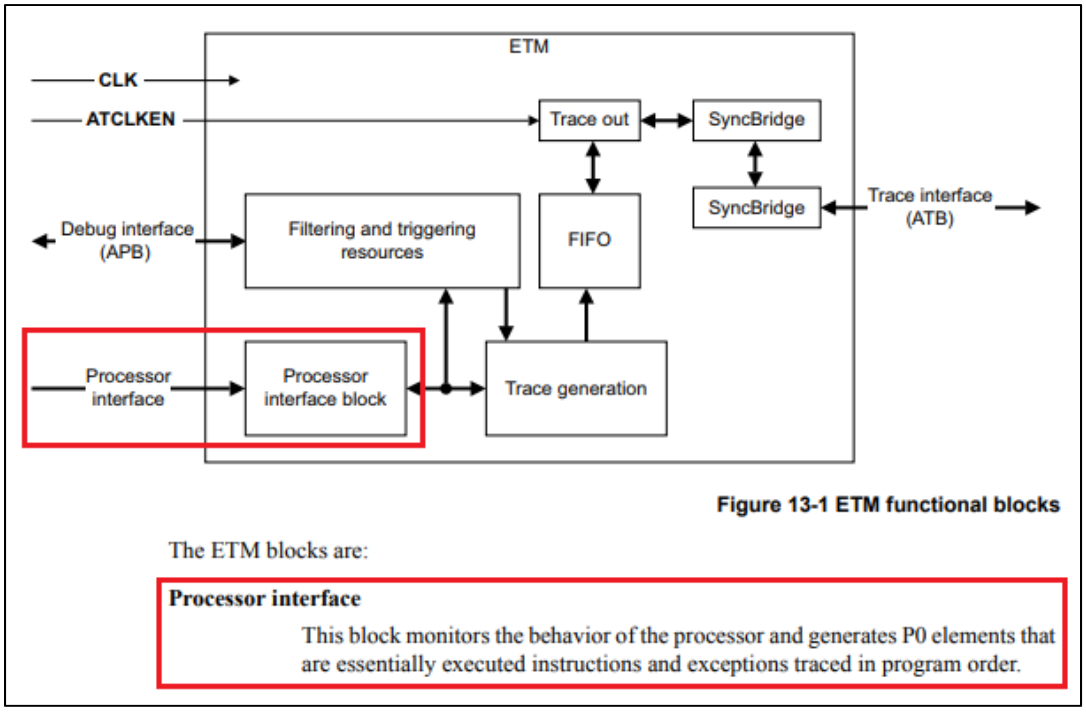


Figure 13-1 ETM functional blocks

The ETM blocks are:

Processor interface

This block monitors the behavior of the processor and generates P0 elements that are essentially executed instructions and exceptions traced in program order.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

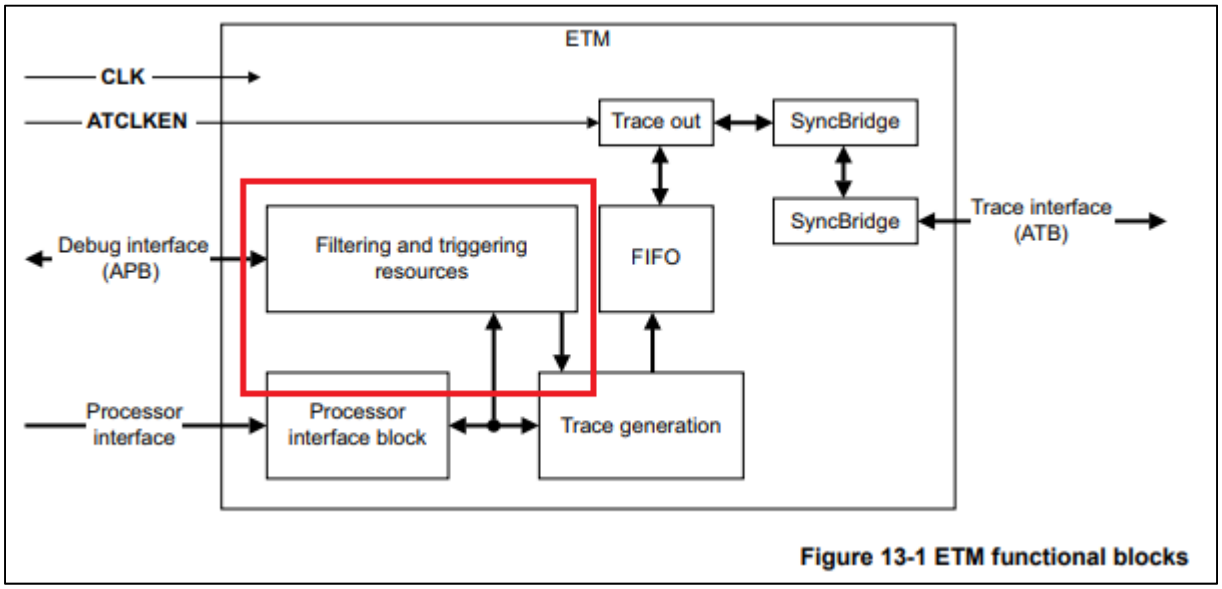


Figure 13-1 ETM functional blocks

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

Filtering and triggering resources

You can filter the ETM trace such as configuring it to trace only in certain address ranges. More complicated logic analyzer style filtering options are also available.

The ETM can also generate a trigger that is a signal to the trace capture device to stop capturing trace.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

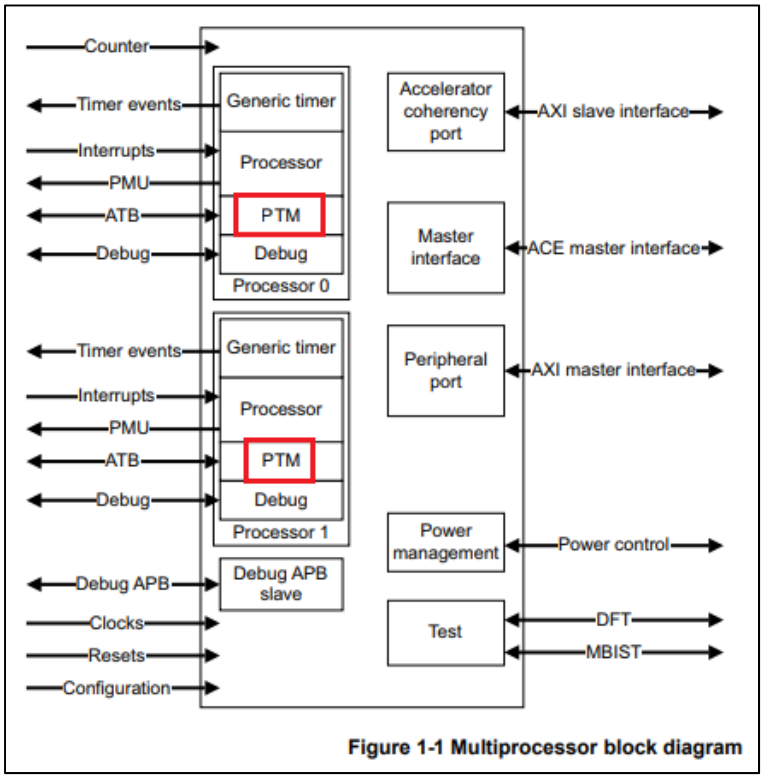


Figure 1-1 Multiprocessor block diagram

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

The PTM is a real-time instruction flow trace module that complies with the *Program Flow Trace* (PFTv1.1) architecture. The PTM is a CoreSight component, and is an integral part of the ARM Real-time Debug solution, DS-5.

For more information see:

- *ARM® CoreSight™ Architecture Specification* (ARM IHI 0029).
- *ARM® CoreSight™ SoC Technical Reference Manual* (ARM DDI 0480).

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

Embedded Trace Macrocell architecture

The Cortex-A53 processor implements the ETMv4 architecture. See the *ARM® ETM™ Architecture Specification, ETMv4*.

Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf

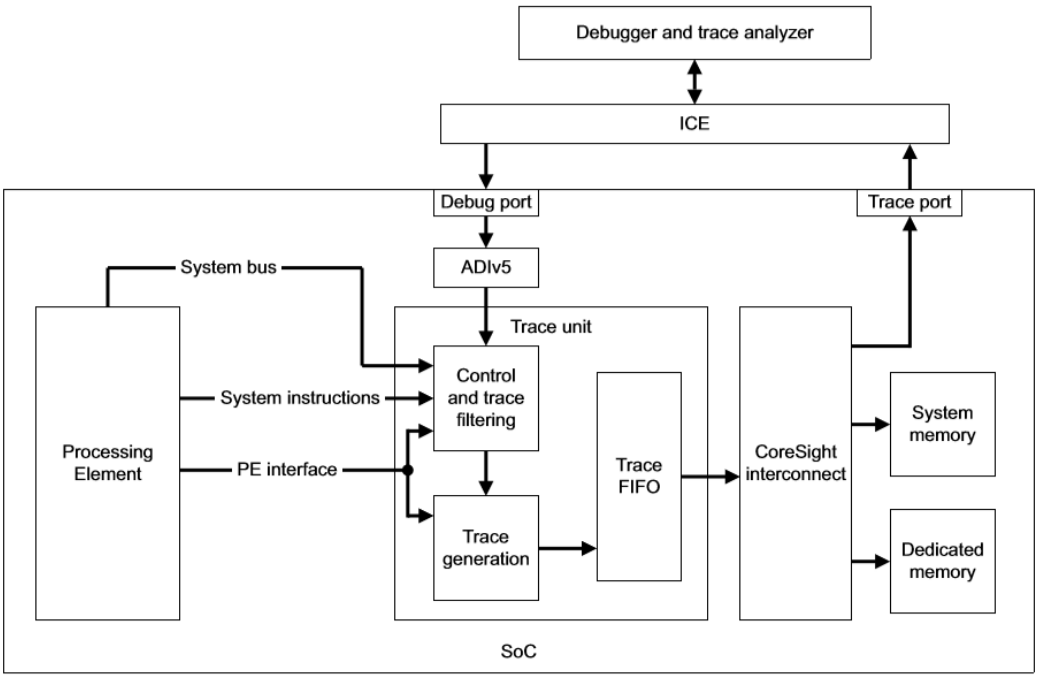


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

Embedded Trace Macrocell architecture

The processor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf

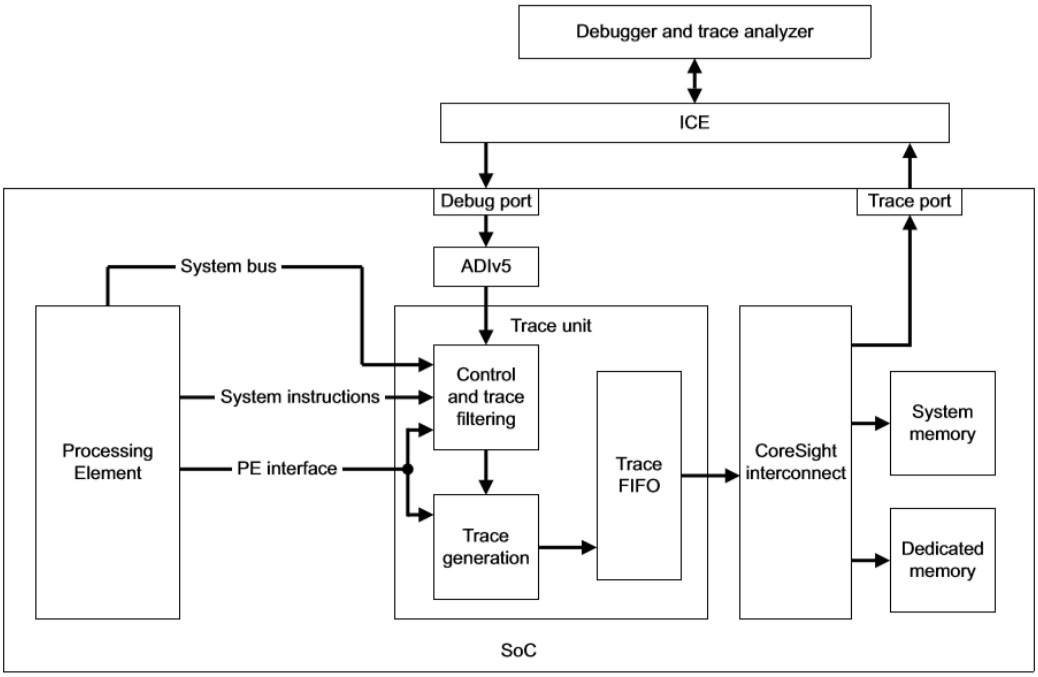


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

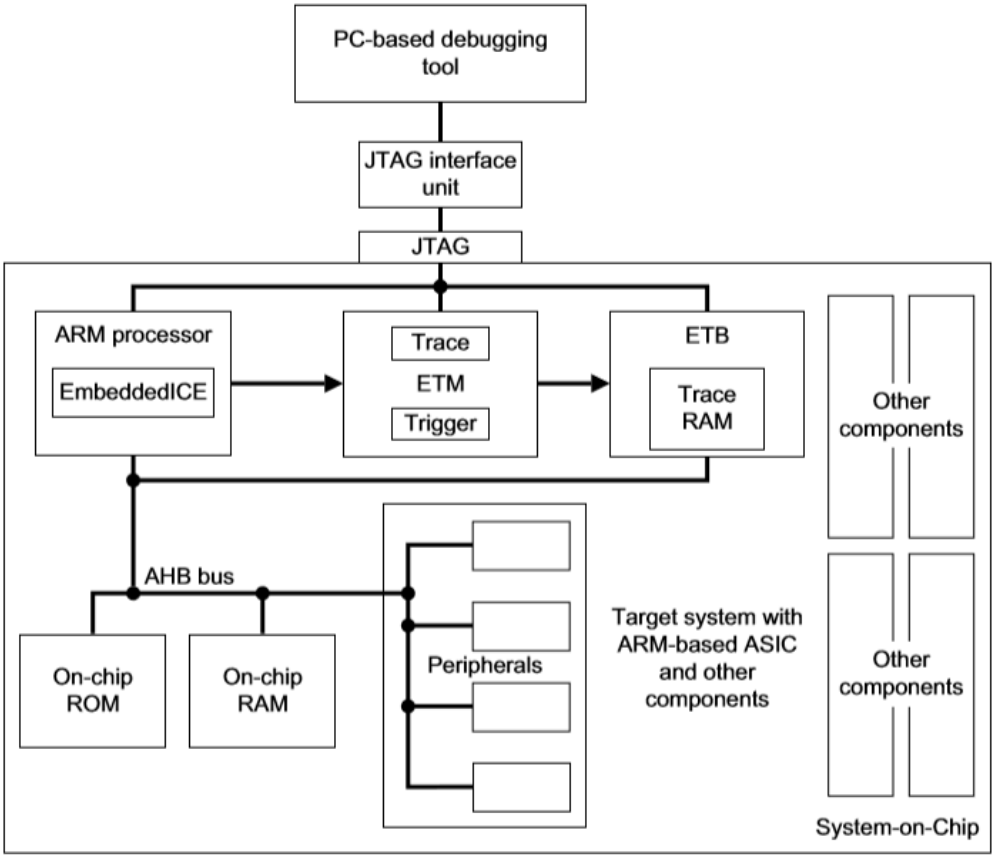
https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

About the ETM

The ETM is a CoreSight™ component designed for use with the CoreSight Design Kit. CoreSight is the ARM extensible, system-wide debug and trace architecture. The Cortex-A8 processor implements the ETM architecture v3.3.

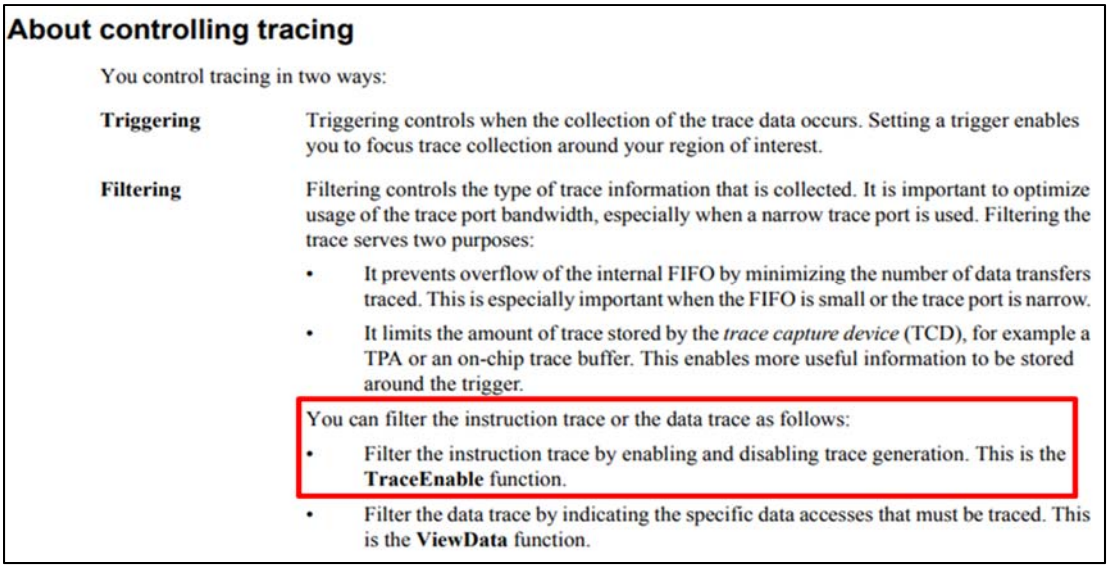
Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf



Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification

downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf



About controlling tracing

You control tracing in two ways:

Triggering — Triggering controls when the collection of the trace data occurs. Setting a trigger enables you to focus trace collection around your region of interest.

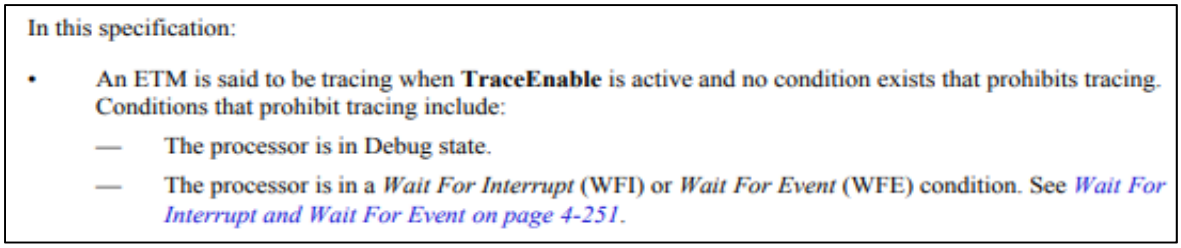
Filtering — Filtering controls the type of trace information that is collected. It is important to optimize usage of the trace port bandwidth, especially when a narrow trace port is used. Filtering the trace serves two purposes:

- It prevents overflow of the internal FIFO by minimizing the number of data transfers traced. This is especially important when the FIFO is small or the trace port is narrow.
- It limits the amount of trace stored by the *trace capture device* (TCD), for example a TPA or an on-chip trace buffer. This enables more useful information to be stored around the trigger.

You can filter the instruction trace or the data trace as follows:

- Filter the instruction trace by enabling and disabling trace generation. This is the **TraceEnable** function.
- Filter the data trace by indicating the specific data accesses that must be traced. This is the **ViewData** function.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf



In this specification:

- An ETM is said to be tracing when **TraceEnable** is active and no condition exists that prohibits tracing. Conditions that prohibit tracing include:
  - The processor is in Debug state.
  - The processor is in a *Wait For Interrupt* (WFI) or *Wait For Event* (WFE) condition. See *Wait For Interrupt and Wait For Event on page 4-251*.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

60. The accused products include a multiplicity of probe lines.

61. The accused products include each of said probe lines being adapted to capture signals from said logic blocks and to propagate said signals to one of said multiplicity of input ports of said on-chip logic analyzer.

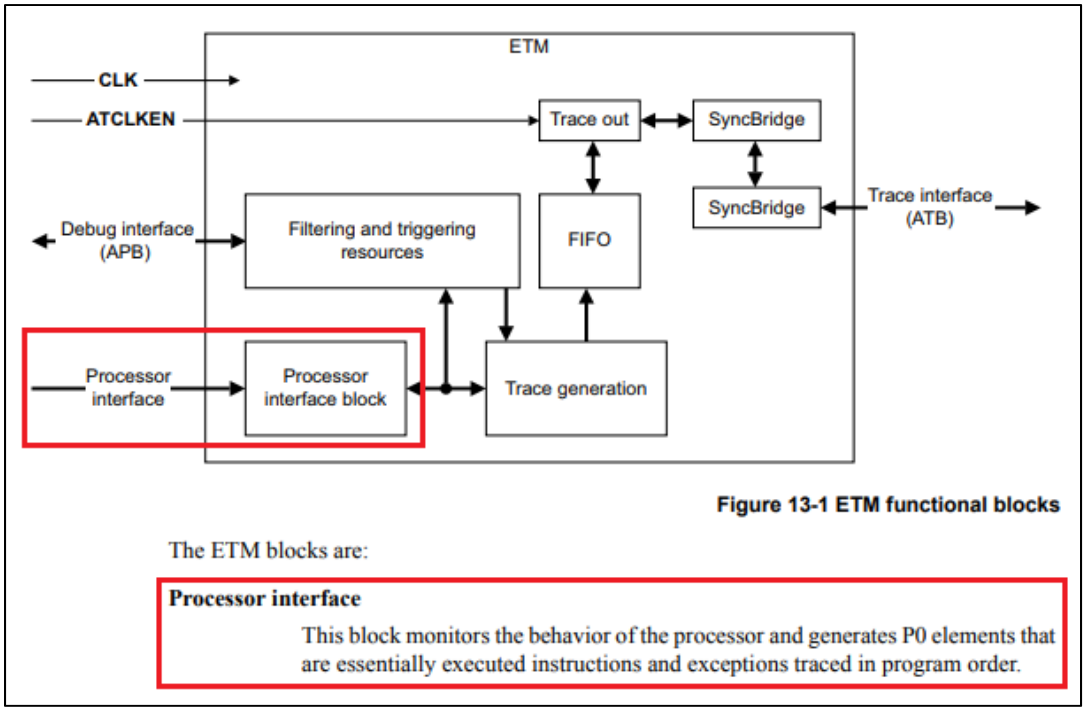


Figure 13-1 ETM functional blocks

The ETM blocks are:

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This block monitors the behavior of the processor and generates P0 elements that are essentially executed instructions and exceptions traced in program order.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

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You can filter the ETM trace such as configuring it to trace only in certain address ranges. More complicated logic analyzer style filtering options are also available.

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Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

The ETM is a module that performs real-time instruction flow tracing based on the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*. The ETM is a CoreSight component, and is an integral part of the ARM Real-time Debug solution, RealView. See the CoreSight documentation in *Additional reading* on page xi for more information.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

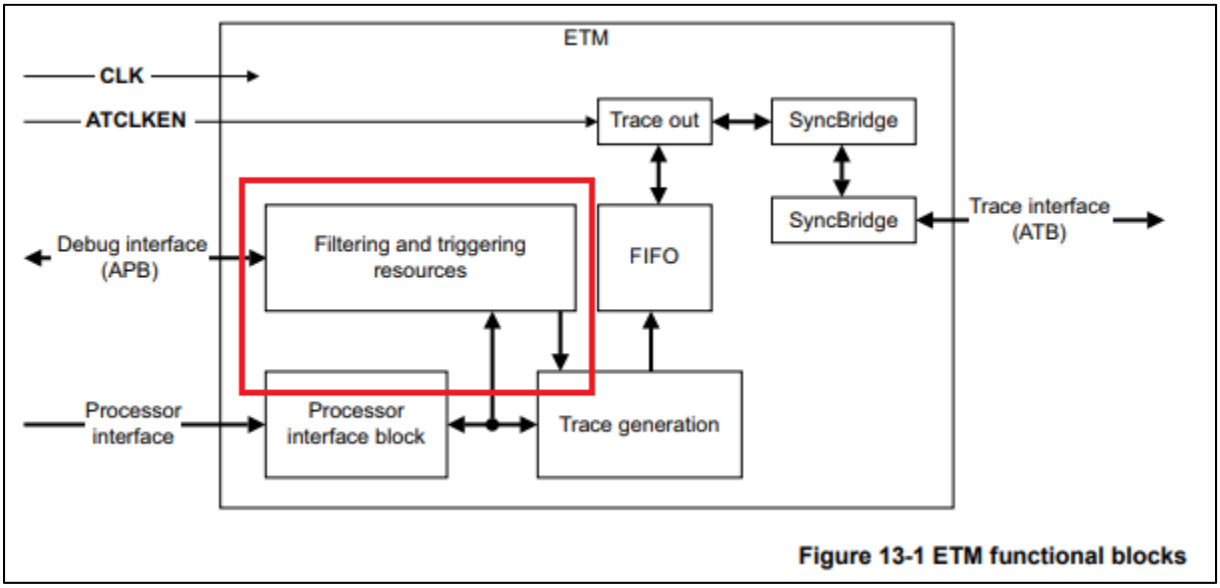

Figure 13-1 ETM functional blocks

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

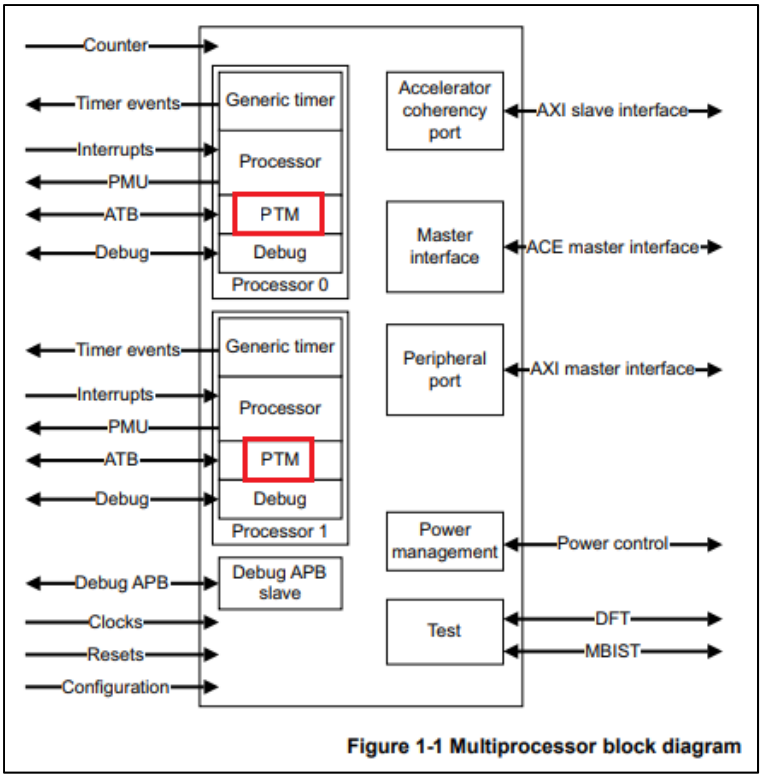

Figure 1-1 Multiprocessor block diagram

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

The PTM is a real-time instruction flow trace module that complies with the *Program Flow Trace* (PFTv1.1) architecture. The PTM is a CoreSight component, and is an integral part of the ARM Real-time Debug solution, DS-5.

For more information see:

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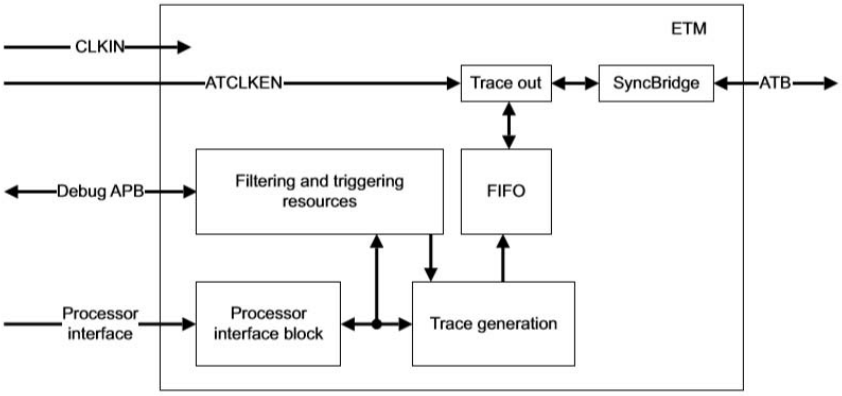
https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

13.3 ETM trace unit functional description

This section describes the ETM trace unit. It contains the following sections:

- *Processor interface*.
- *Trace generation*.
- *Filtering and triggering resources*.
- *FIFO*.
- *Trace out* on page 13-6.
- *Syncbridge* on page 13-6.

Figure 13-1 shows the main functional blocks of the ETM trace unit.



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Source: ARM Cortex-A53 MPCore Processor manual downloaded from

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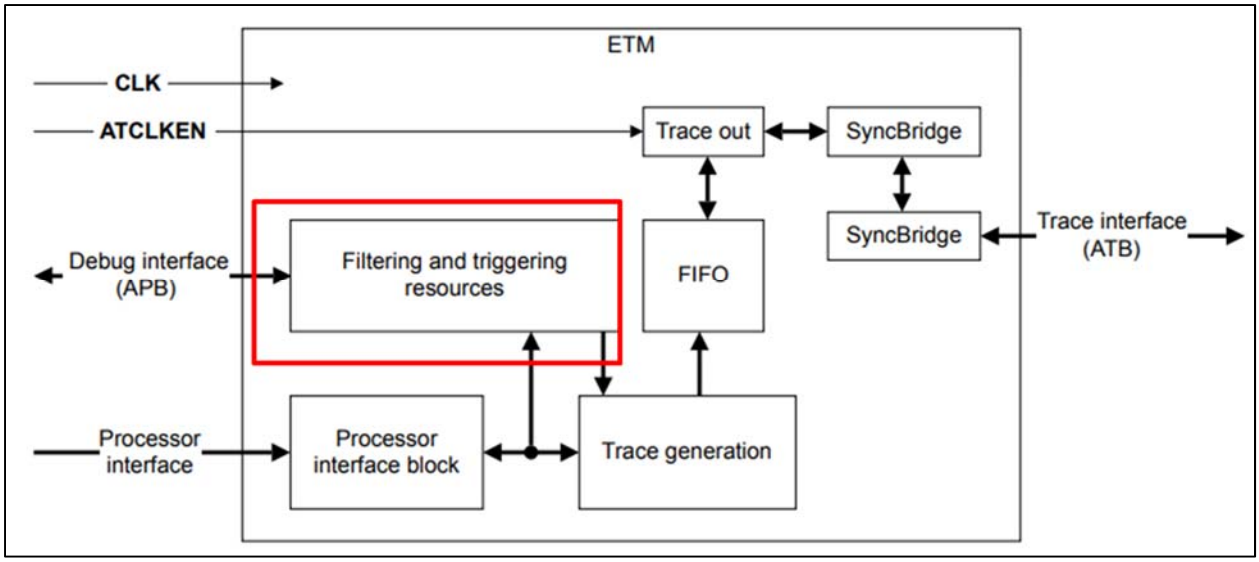
Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf



Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf

The ETM has the following main features:

Core interface module

The core interface module monitors the behavior of the processor.

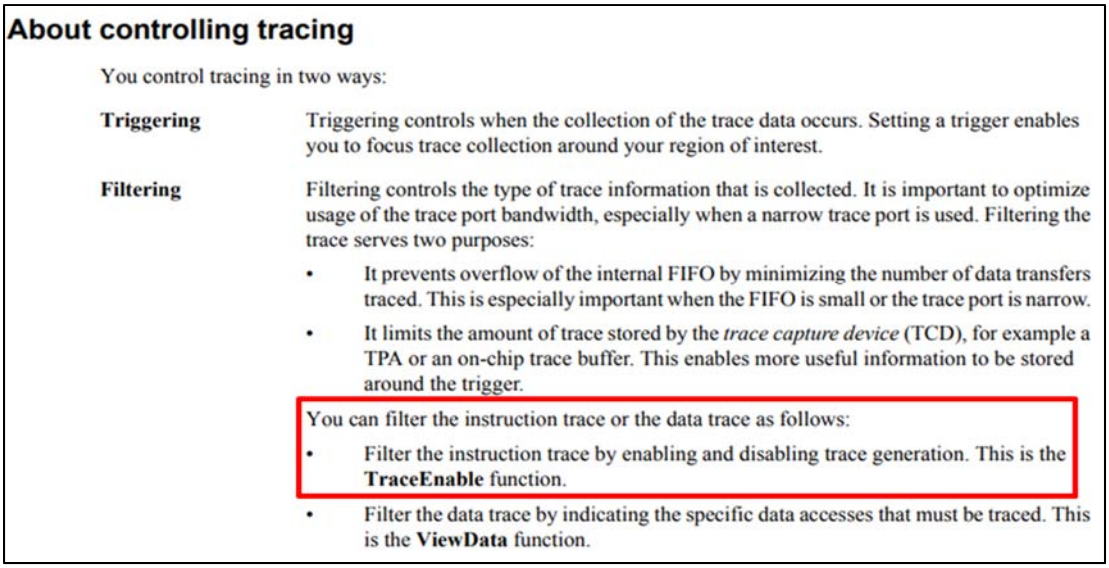
Trace generation

The ETM generates a real-time trace that can be configured to include:

- instruction tracing containing:
  - the addresses of executed instructions
  - passed or failed condition codes of the instructions
  - information about exceptions
  - context IDs.
- data address tracing containing the addresses of data transfers as viewed by the ARM architecture.

Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf



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- Filter the data trace by indicating the specific data accesses that must be traced. This is the **ViewData** function.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

62. The input ports of the on-chip logic analyzer of the accused products comprises means to capture said signals from said probe lines.

63. The input ports of the on-chip logic analyzer of the accused products comprises means to align said signals propagated through said probe lines to create aligned signals.

64. The input ports of the on-chip logic analyzer of the accused products comprises means to capture said aligned signals.

65. Defendants have had knowledge of the ‘001 Patent at least as of the date when they were notified of the filing of this action.

66. On November 23, 2005, the parent of the ‘001 Patent (U.S. Patent No. 6,687,865) was cited by the Examiner during prosecution of U.S. Patent No. 7,567,892, which is assigned to Broadcom Corp. The Examiner in that prosecution explained that the parent of the ‘001 Patent was pertinent because “Dervisoglu et al. (U.S. Patent No. 6,687,865) discloses an on-chip service processor for testing and debugging of integrated circuits.” Broadcom employees Geoff Barrett,

Simon Christopher Dequin Clemow, and Andrew Jon Dawson, who are listed as inventors on U.S. Patent No. 7,567,892, Robert Sokohl, Jeffrey S. Weaver, and others involved in the prosecution of the patent, have had knowledge of the '001 Patent well before this suit was filed.

67. On March 6, 2006, the parent of the '001 Patent (U.S. Patent No. 6,687,865) was cited in an IDS during prosecution of U.S. Patent No. 7,533,315, which is assigned to Mediatek Inc. During that same prosecution, the Examiner also cited the child of the '001 Patent (U.S. Patent No. 7,080,301) on June 18, 2008. MediaTek employees I-Chieh Han and You-Ming Chiu, who are listed as inventors on U.S. Patent No. 7,533,315, Daniel R. McClure, and others involved in the prosecution of the patent, have had knowledge of the '001 Patent well before this suit was filed.

68. American Patents has been damaged as a result of the infringing conduct by Defendants alleged above. Thus, Defendants are liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

69. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '001 Patent.

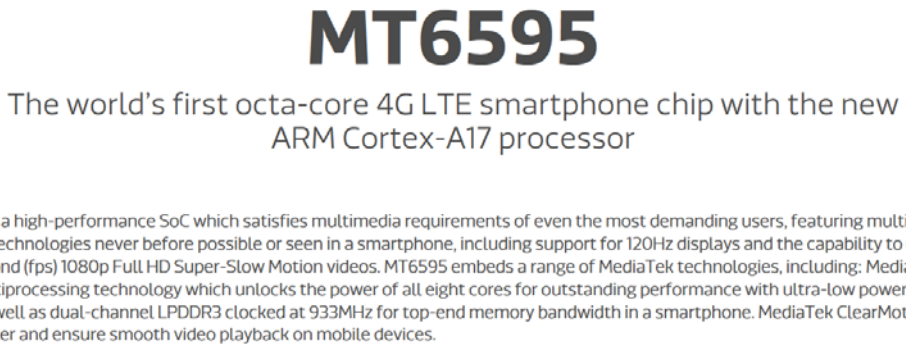
COUNT II

DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,836,371

70. On November 16, 2010, United States Patent No. 7,836,371 ("the '371 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "On-Chip Service Processor."

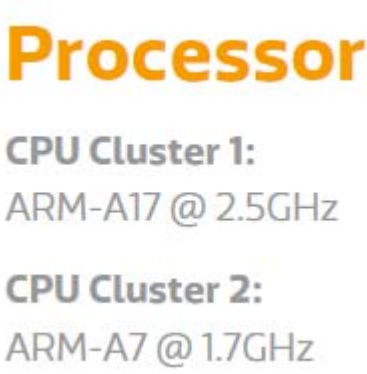
71. American Patents is the owner of the '371 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '371 Patent against infringers, and to collect damages for all relevant times.

72. MediaTek made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its MT6595, Helio X10, and Helio X27 families of products that include advanced on-chip service capabilities ("accused products")[4]:

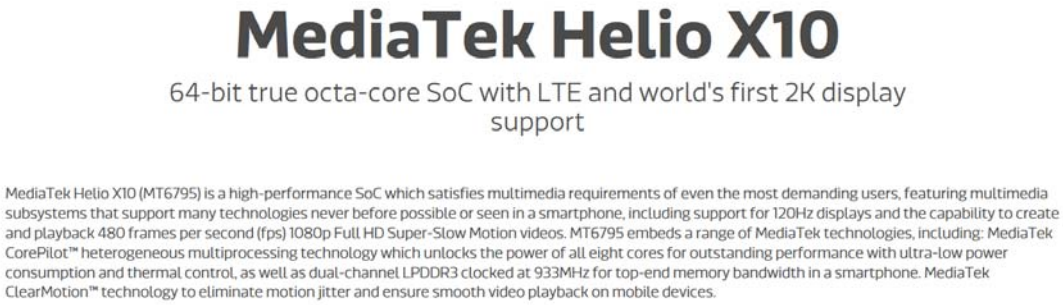


Source: https://www.mediatek.com/products/smartphones/mt6595

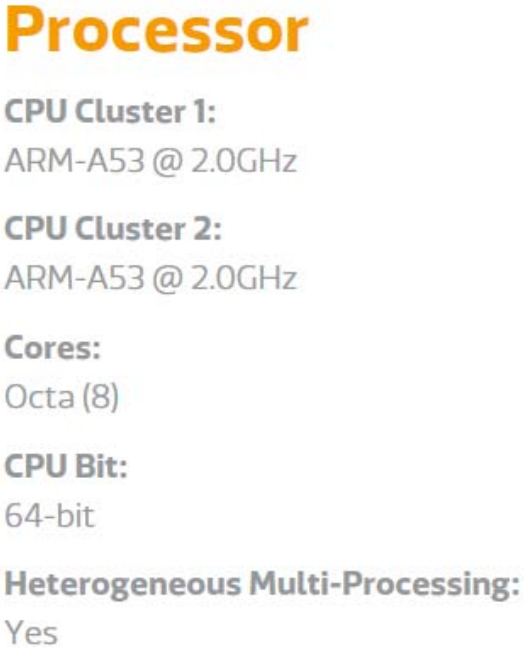
[4] A non-exhaustive list of additional accused products includes the MT6739, MT6750, MT6752, MT6753, Helio P, Helio A22, MT7622, MT7623, MT8x series (including MT8173, MT8176, MT8783, MT8785, and MT8163), and Helio X series (including Helio X20, Helio X23, and Helio X25) families of products that include advanced on-chip service capabilities.



Source: https://www.mediatek.com/products/smartphones/mt6595

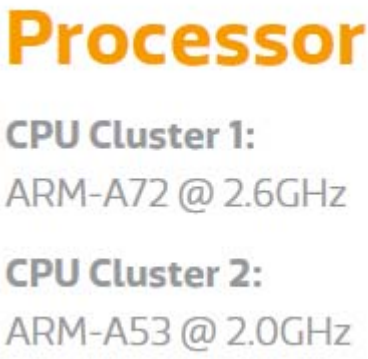


Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10



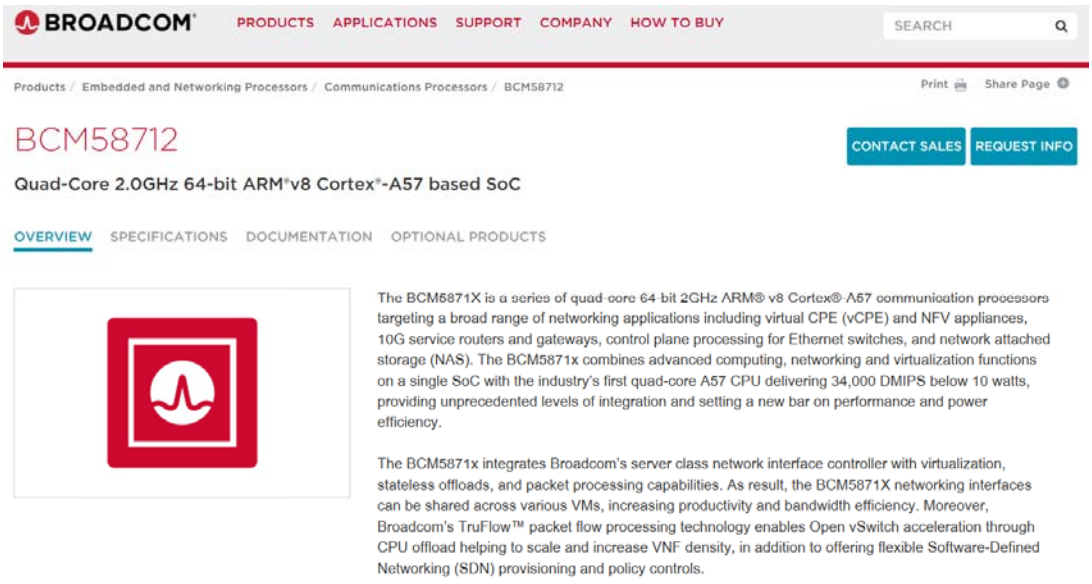
Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10

Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

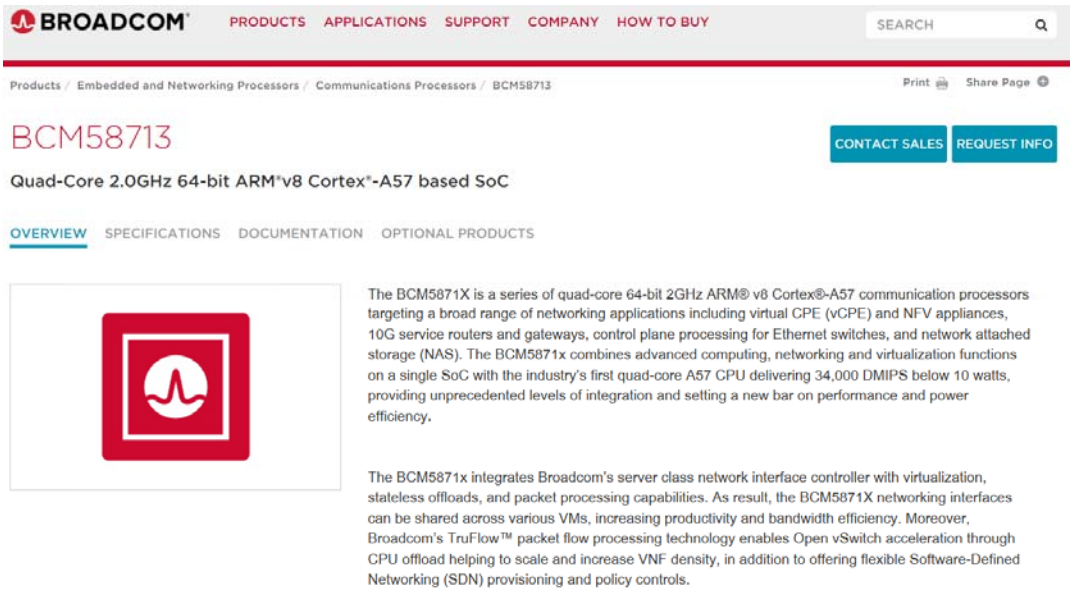


Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

73. Broadcom made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its BCM58712 and BCM58713 families of products that include advanced on-chip service capabilities ("accused products"):

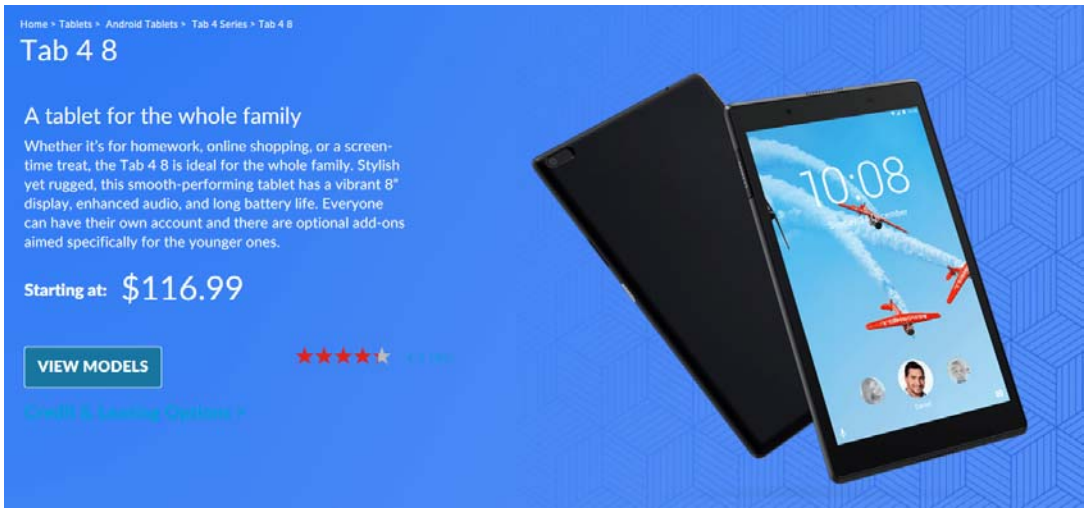


Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58712/



Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58713/

74. Lenovo made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Lenovo Tab 4 8, Lenovo Tab 4 10, and Lenovo Tab 3 10 families of products that include advanced on-chip service capabilities ("accused products"):



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

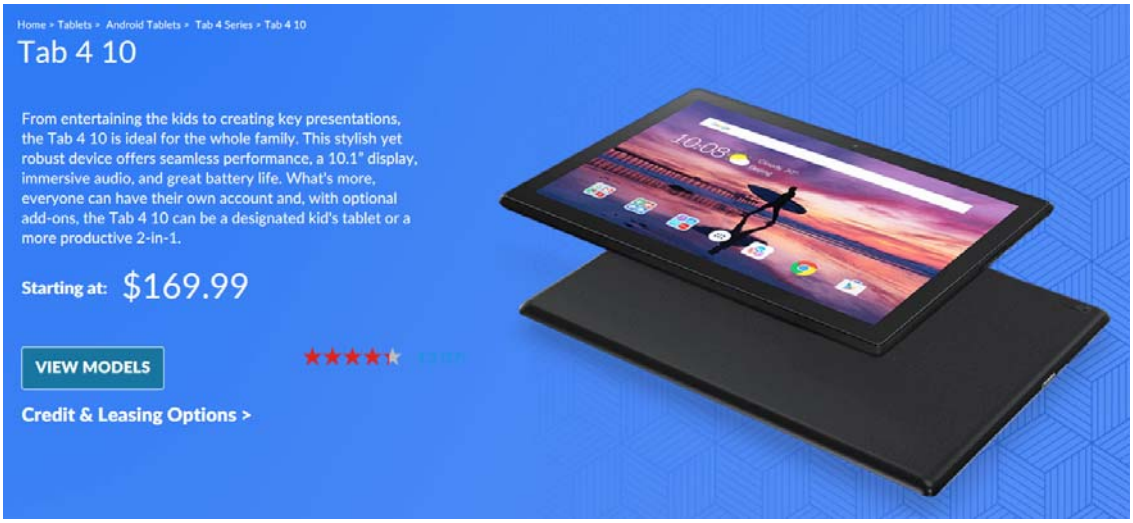
Processor	Qualcomm® Snapdragon™ MSM8917 Processor (1.4 GHz)
Operating System	Android™ Nougat 7.1

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

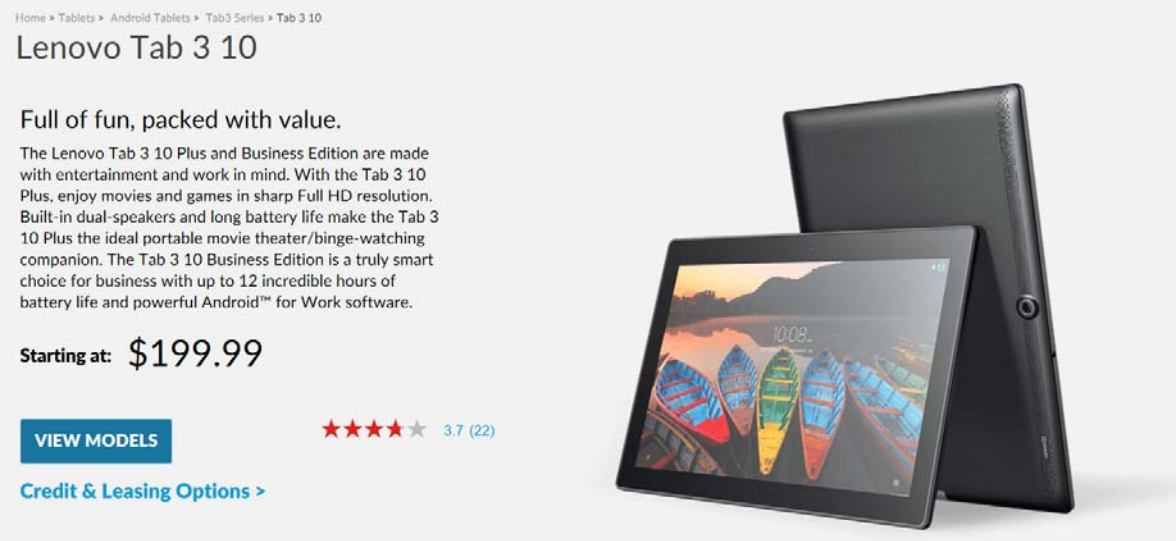
Processor	Qualcomm® Snapdragon™ APQ8017 Processor (1.40GHz)

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

Processor	MediaTek™ 8161 Quad-Core Processor (1.30GHz 1MB)

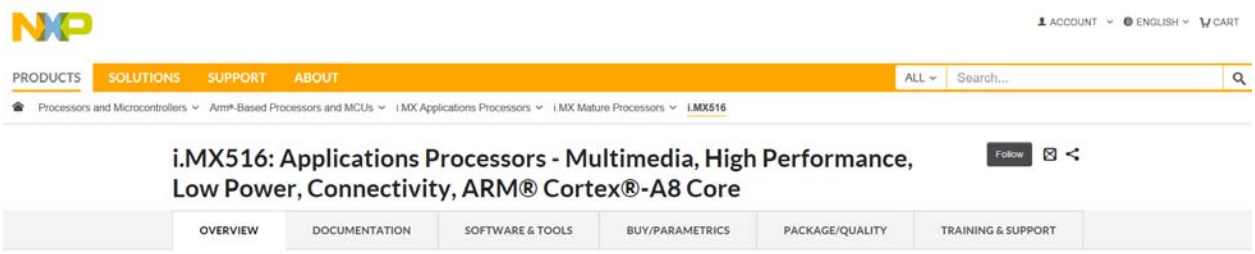
Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

> The MediaTek MT8161 is an ARM based entry-level to mid-range SoC for (Android based) tablets. It offers four ARM Cortex-A53 processor cores (quad-core) that are clocked with up to 1.3 GHz. Furthermore, an ARM Mali-720 graphics card, a LPDDR3 memory controller (e.g., accessing 1 GB in the Lenovo Tab 2 A8-50), Bluetooth 4.0 and dual-band 802.11 b/g/n are integrated in the SoC.

Source: https://www.notebookcheck.net/Mediatek-MT8161-Tablet-SoC.145089.0.html

75. NXP made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its i.MX516, S32V234,

and i.MX 8QuadMax families of products that include advanced on-chip service capabilities ("accused products")[5]:



Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-mature-processors/applications-processors-multimedia-high-performance-low-power-connectivity-arm-cortex-a8-core:i.MX516

Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/s32-automotive-platform/vision-processor-for-front-and-surround-view-camera-machine-learning-and-sensor-fusion-applications:S32V234

[5] A non-exhaustive list of additional accused products includes the i.MX 7 series, i.MX 8 series, i.MX Mature series, QorIQ Layerscape series, i.MX534, i.MX535, i.MX537, i.MX8M, and i.MX 8QuadPlus families of products that include advanced on-chip service capabilities.

Feature	i.MX 8QuadMax	i.MX 8QuadPlus
ARM® Core	2 x ARM Cortex®-A72	1 x Cortex-A72
ARM Core	4 x Cortex-A53	4 x Cortex-A53
ARM Core	2 x Cortex-M4F	2 x Cortex-M4F

Source: fact sheet downloaded from https://www.nxp.com/docs/en/fact-sheet/IMX8FAMFS.pdf

76. Qualcomm made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Snapdragon 410E and Snapdragon 650 families of products that include advanced on-chip service capabilities ("accused products")[6]:

> Designed to meet the demanding requirements of embedded computing applications with its high performance, energy efficiency, multimedia features, integrated connectivity and long-term support, the Qualcomm® Snapdragon™ 410E embedded platform is an ideal platform for the Internet of Things.

Source: https://www.qualcomm.com/products/apq8016e

> **CPU**
>
> CPU Clock Speed: Up to 1.2 GHz
> CPU Cores: Quad-core CPU, 4x ARM Cortex A53
> CPU Bit Architecture: 64-bit, 32-bit

Source: https://www.qualcomm.com/products/apq8016e

[6] A non-exhaustive list of additional accused products includes the Snapdragon 400 tier (including Snapdragon 439 (SDM439), Snapdragon 450, Snapdragon 427 (MSM8920), and Snapdragon 435 (MSM8940)), MSM8956, the Snapdragon 600 tier (including Snapdragon 652 (MSM8976), and Snapdragon 653 (MSM8976 Pro)) families of products that include advanced on-chip service capabilities.

Snapdragon 650 Mobile Platform

The Qualcomm® Snapdragon™ 650 mobile platform supports high-quality, efficient performance, multimedia, gaming and connectivity, thanks to its powerful 64-bit capable hexa-core CPUs, integrated Qualcomm® Snapdragon™ X8 LTE with Cat 7 speeds, Qualcomm® Adreno™ 510 GPU, and support for 4K Ultra HD video.

Source: https://www.qualcomm.com/products/snapdragon/processors/650

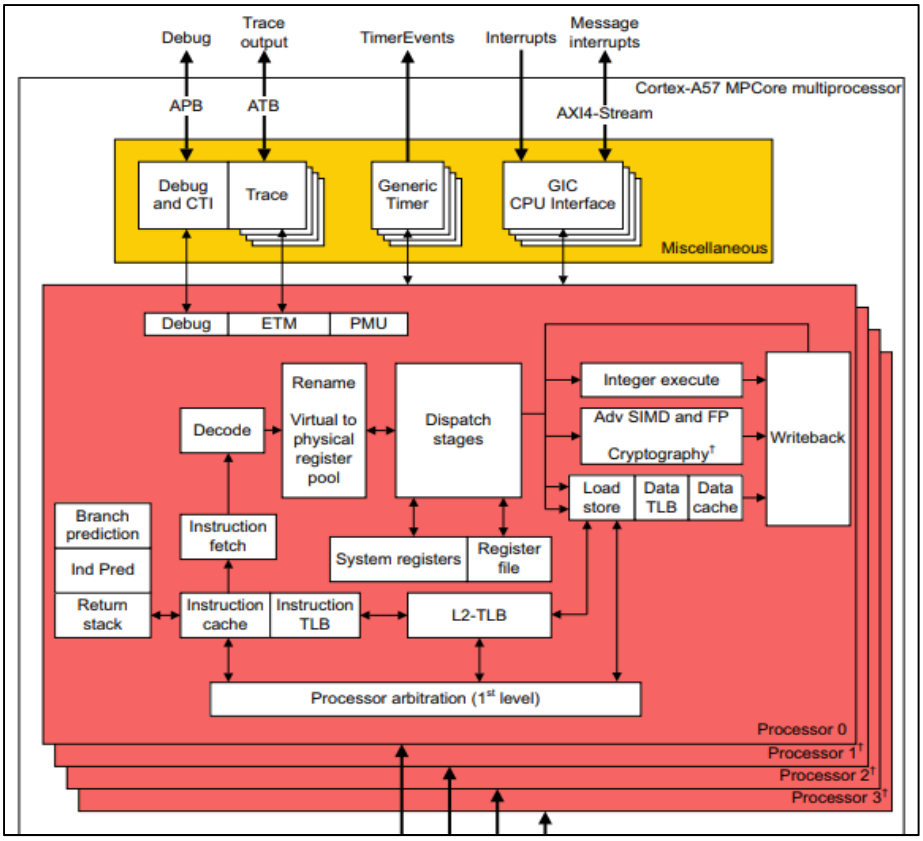
CPU	CPU Clock Speed: Up to 1.8 GHz CPU Cores: Hexa-core CPU, 2x ARM Cortex A72, 4x ARM Cortex A53 CPU Bit Architecture: 64-bit

Source: https://www.qualcomm.com/products/snapdragon/processors/650

77. By doing so, Defendants have directly infringed (literally and/or under the doctrine of equivalents) at least Claim 7 of the '371 Patent. Defendants' infringement in this regard is ongoing.

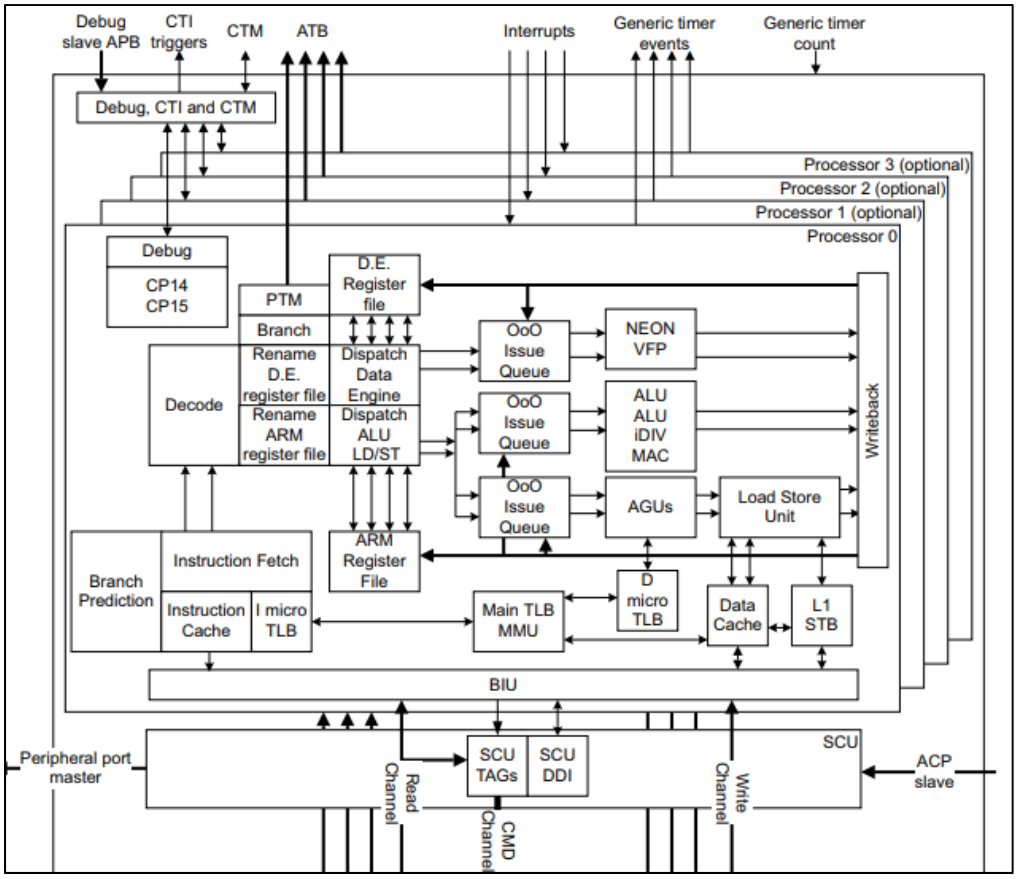
78. Defendants have infringed the '371 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale integrated circuits having advanced on-chip service capabilities.

79. The accused products include one or more logic blocks to generate one or more system-operation signals at one or more system-operation clock rates.



Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf



Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

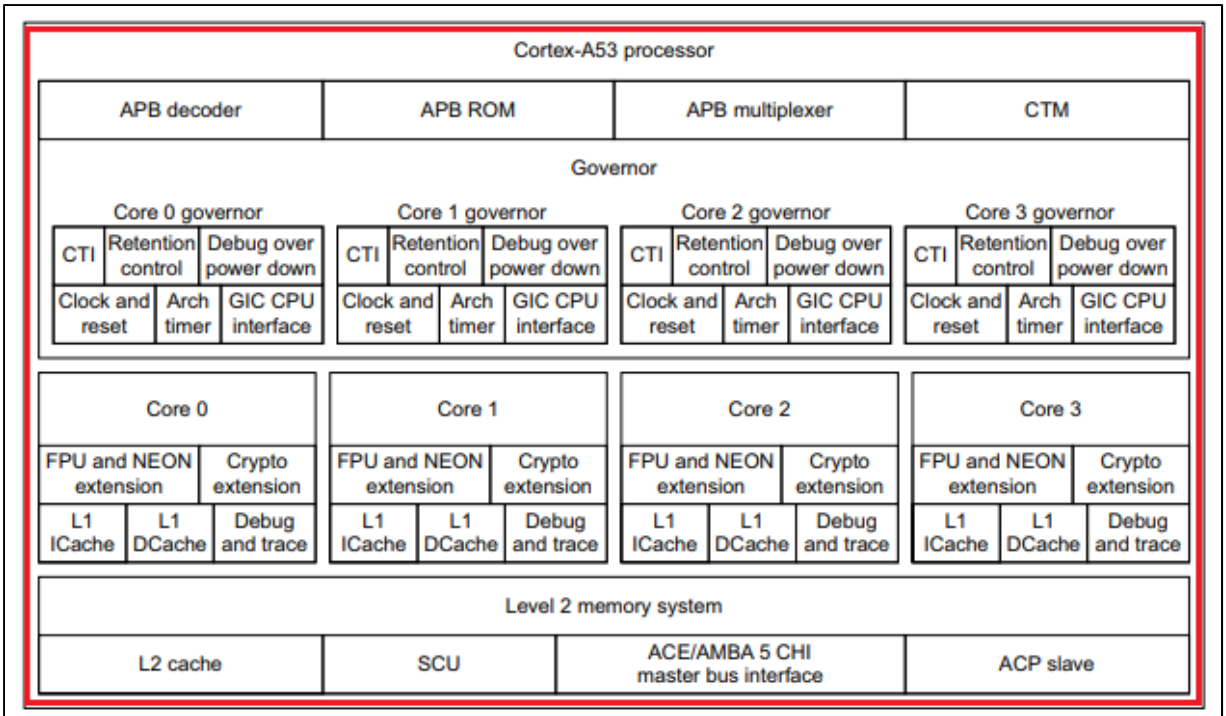
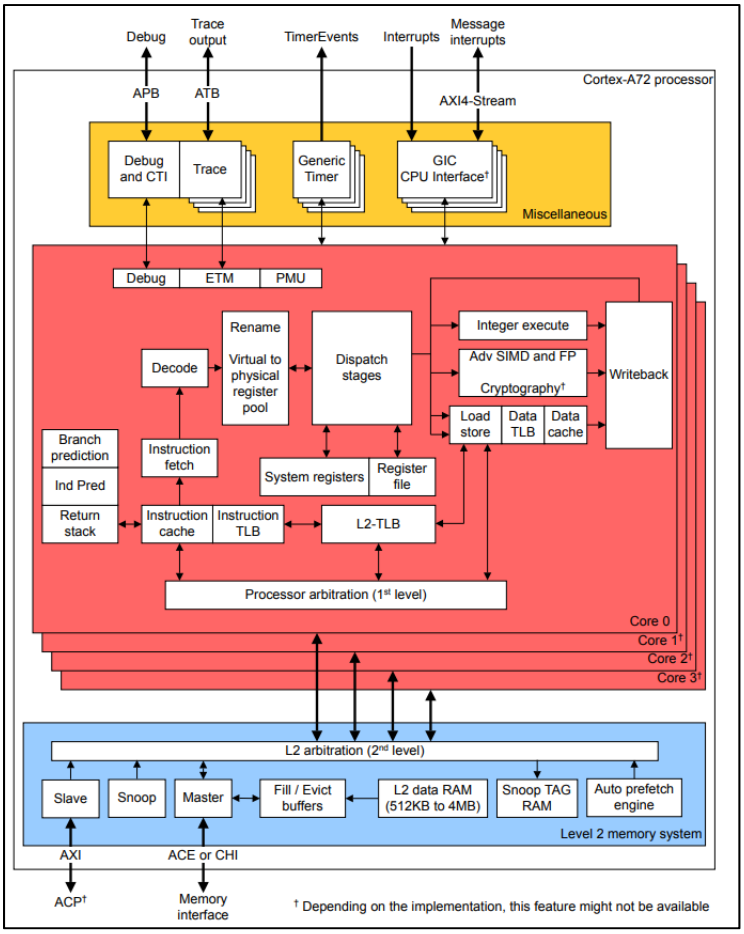


Figure 2-1 Cortex-A53 processor block diagram

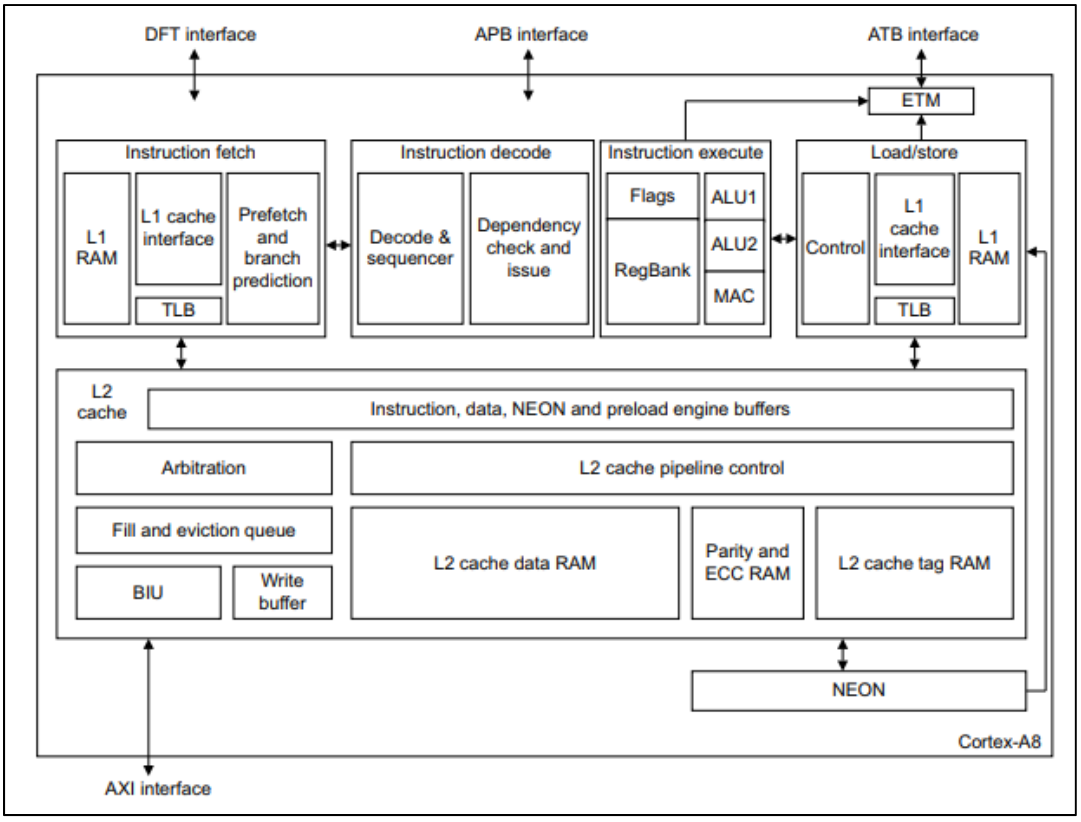
Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf



Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf



Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf

80. The accused products include a system bus.

81. The accused products include a service processor unit comprising a control unit, a buffer memory, and a system bus interface.

82. The accused products include a service processor unit adapted to perform capture and analysis of system operation signals on said system bus during normal system operation through said system bus interface.

Embedded Trace Macrocell architecture

The multiprocessor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4.*

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

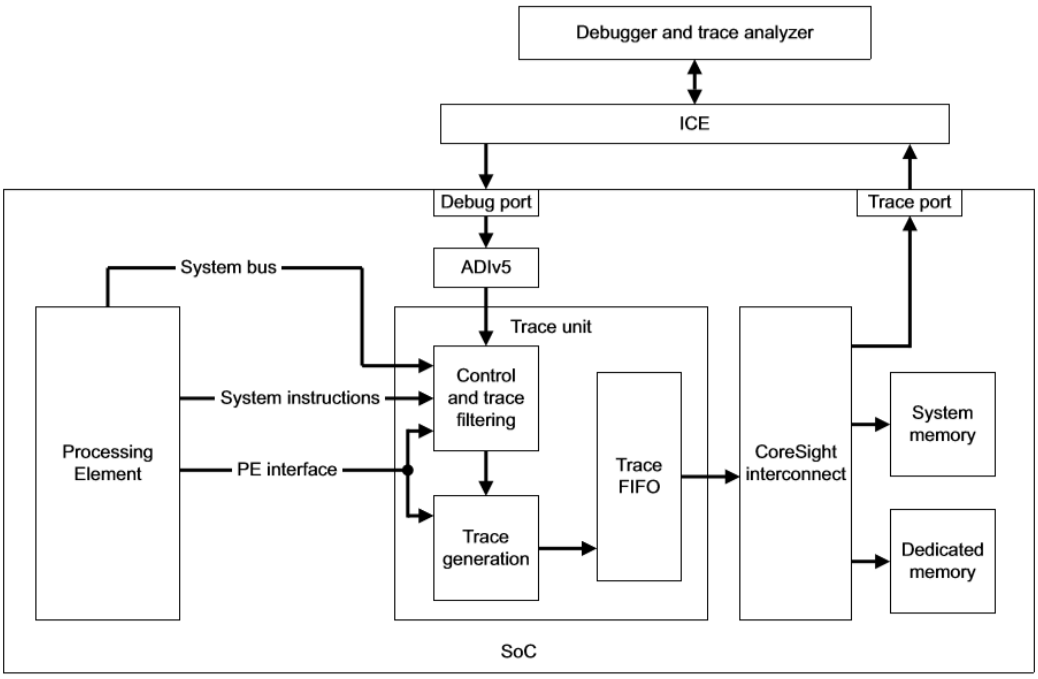


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

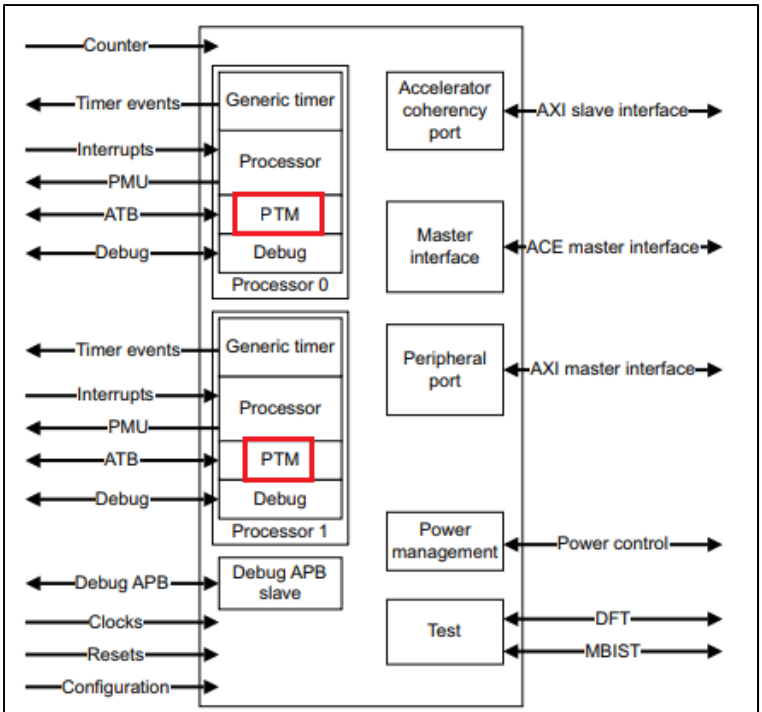


Figure 1-1 Multiprocessor block diagram

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

The PTM is a real-time instruction flow trace module that complies with the *Program Flow Trace* (PFTv1.1) architecture. The PTM is a CoreSight component, and is an integral part of the ARM Real-time Debug solution, DS-5.

For more information see:

- *ARM® CoreSight™ Architecture Specification* (ARM IHI 0029).
- *ARM® CoreSight™ SoC Technical Reference Manual* (ARM DDI 0480).

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

Embedded Trace Macrocell architecture

The Cortex-A53 processor implements the ETMv4 architecture. See the *ARM® ETM™ Architecture Specification, ETMv4*.

Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf

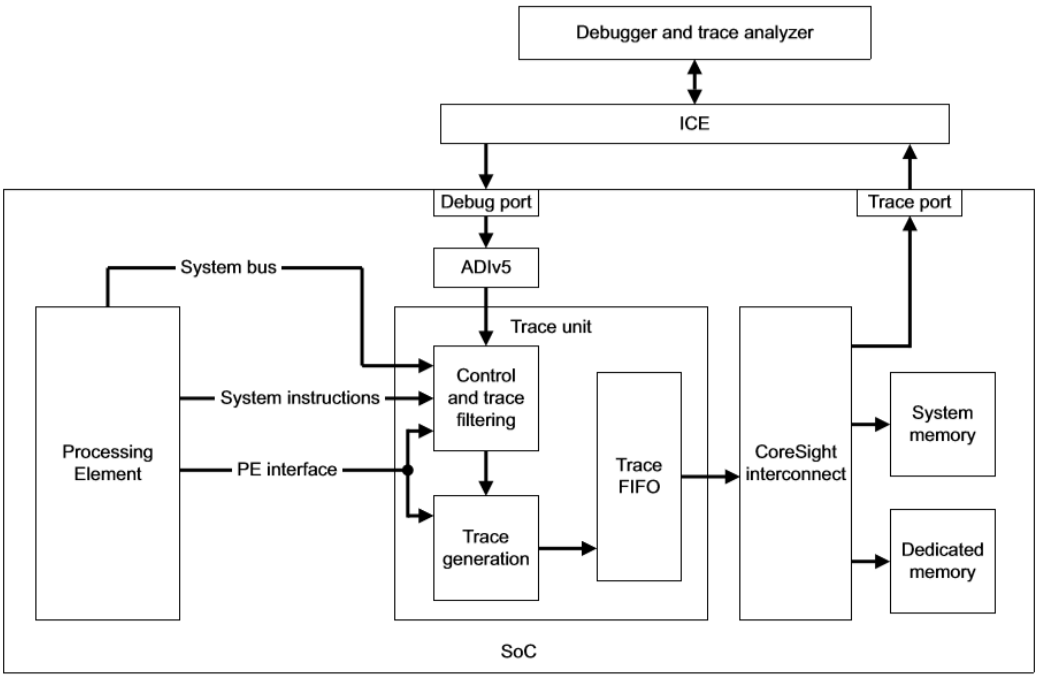


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

Embedded Trace Macrocell architecture

The processor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf

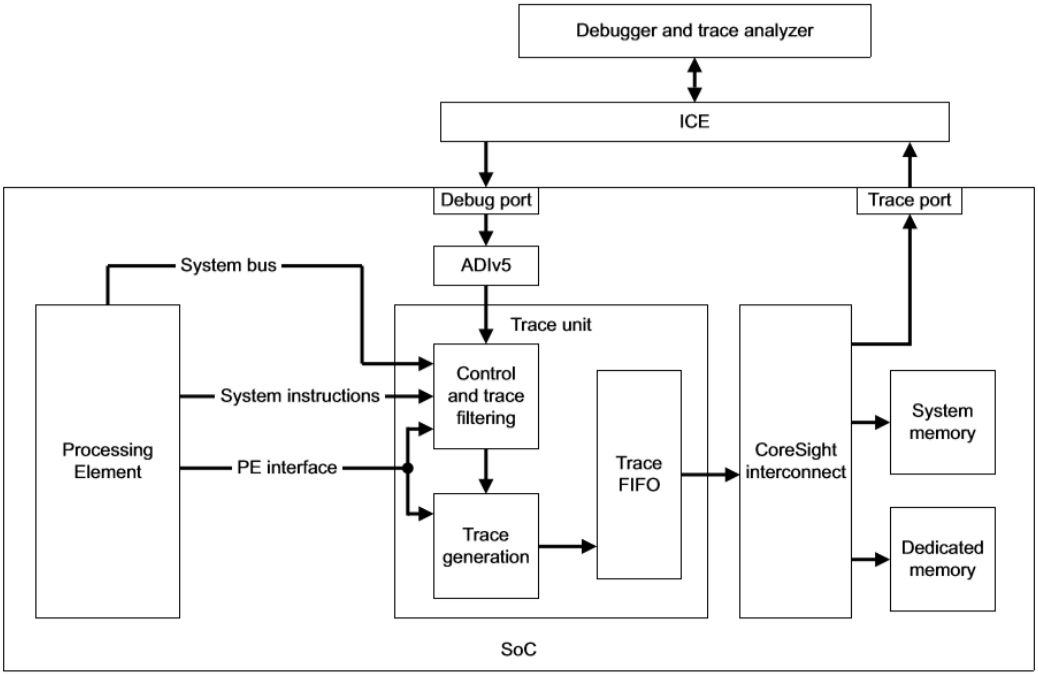


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

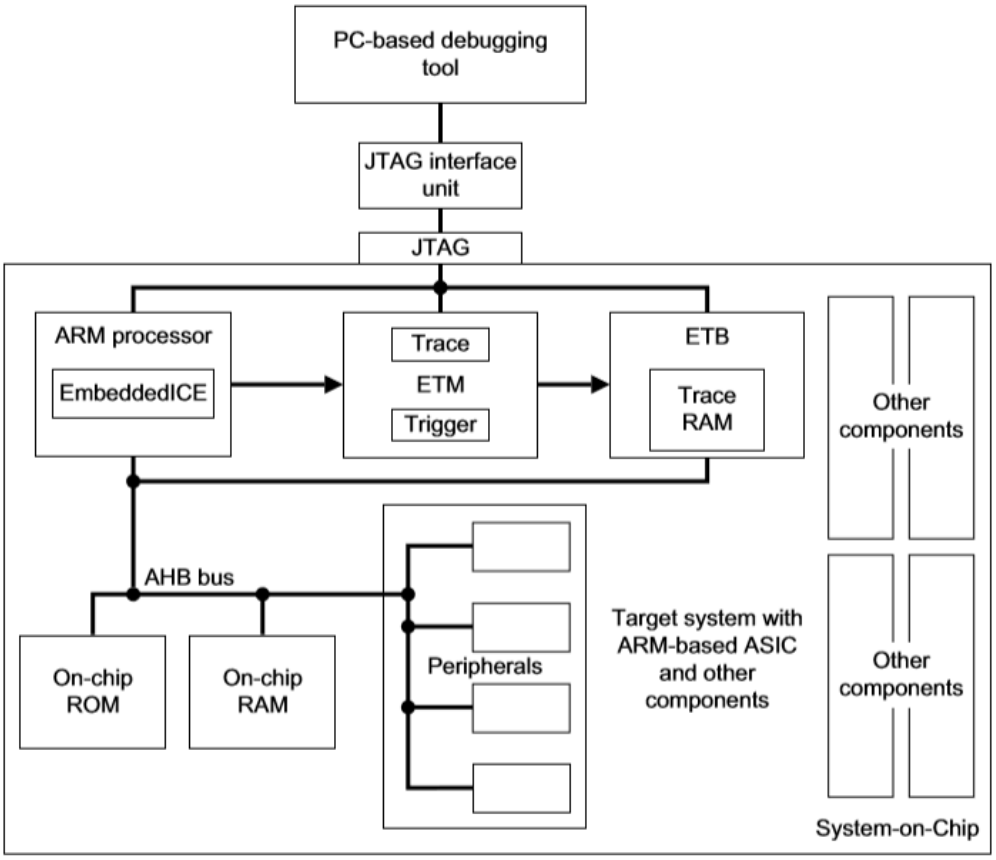
https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

About the ETM

The ETM is a CoreSight™ component designed for use with the CoreSight Design Kit. CoreSight is the ARM extensible, system-wide debug and trace architecture. The Cortex-A8 processor implements the ETM architecture v3.3.

Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf



Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

About controlling tracing

You control tracing in two ways:

Triggering Triggering controls when the collection of the trace data occurs. Setting a trigger enables you to focus trace collection around your region of interest.

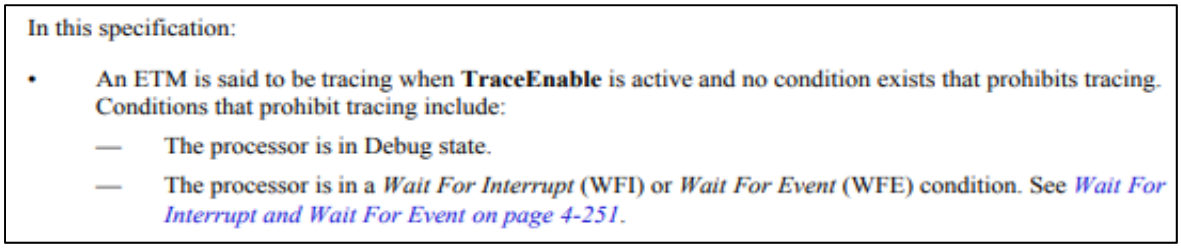
Filtering Filtering controls the type of trace information that is collected. It is important to optimize usage of the trace port bandwidth, especially when a narrow trace port is used. Filtering the trace serves two purposes:

- It prevents overflow of the internal FIFO by minimizing the number of data transfers traced. This is especially important when the FIFO is small or the trace port is narrow.
- It limits the amount of trace stored by the *trace capture device* (TCD), for example a TPA or an on-chip trace buffer. This enables more useful information to be stored around the trigger.

You can filter the instruction trace or the data trace as follows:

- Filter the instruction trace by enabling and disabling trace generation. This is the **TraceEnable** function.
- Filter the data trace by indicating the specific data accesses that must be traced. This is the **ViewData** function.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf



In this specification:

- An ETM is said to be tracing when **TraceEnable** is active and no condition exists that prohibits tracing. Conditions that prohibit tracing include:
  - The processor is in Debug state.
  - The processor is in a *Wait For Interrupt* (WFI) or *Wait For Event* (WFE) condition. See *Wait For Interrupt and Wait For Event on page 4-251*.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

83. Defendants have had knowledge of the '371 Patent at least as of the date when they were notified of the filing of this action.

84. On November 23, 2005, the great-grandparent of the '371 Patent (U.S. Patent No. 6,687,865) was cited by the Examiner during prosecution of U.S. Patent No. 7,567,892, which is assigned to Broadcom Corp. The Examiner in that prosecution explained that the great-grandparent of the '371 Patent was pertinent because "Dervisoglu et al. (U.S. Patent No. 6,687,865) discloses an on-chip service processor for testing and debugging of integrated circuits." Broadcom employees Geoff Barrett, Simon Christopher Dequin Clemow, and Andrew Jon Dawson, who are listed as inventors on U.S. Patent No. 7,567,892, Robert Sokohl, Jeffrey S. Weaver, and others involved in the prosecution of the patent, have had knowledge of the '371 Patent well before this suit was filed.

85. On March 6, 2006, the great-grandparent of the '371 Patent (U.S. Patent No. 6,687,865) was cited in an IDS during prosecution of U.S. Patent No. 7,533,315, which is assigned to Mediatek Inc. During that same prosecution, the Examiner also cited the parent of the '371 Patent (U.S. Patent No. 7,080,301) on June 18, 2008. MediaTek employees I-Chieh Han and You-Ming Chiu, who are listed as inventors on U.S. Patent No. 7,533,315, Daniel R.

McClure, and others involved in the prosecution of the patent, have had knowledge of the '371 Patent well before this suit was filed.

86. American Patents has been damaged as a result of the infringing conduct by Defendants alleged above. Thus, Defendants are liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

87. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '371 Patent.

COUNT III

DIRECT INFRINGEMENT OF U.S. PATENT NO. 8,239,716

88. On August 7, 2012, United States Patent No. 8,239,716 ("the '716 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "On-Chip Service Processor."

89. American Patents is the owner of the '716 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '716 Patent against infringers, and to collect damages for all relevant times.

90. MediaTek made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its MT6595, Helio X10, and Helio X27 families of products that include advanced on-chip service capabilities ("accused products")[7]:

[7] A non-exhaustive list of additional accused products includes the MT6739, MT6750, MT6752, MT6753, Helio P, Helio A22, MT7622, MT7623, MT8x series (including MT8173, MT8176,

MT6595

The world's first octa-core 4G LTE smartphone chip with the new ARM Cortex-A17 processor

MediaTek MT6795 is a high-performance SoC which satisfies multimedia requirements of even the most demanding users, featuring multimedia subsystems that support many technologies never before possible or seen in a smartphone, including support for 120Hz displays and the capability to create and playback 480 frames per second (fps) 1080p Full HD Super-Slow Motion videos. MT6595 embeds a range of MediaTek technologies, including: MediaTek CorePilot™ heterogeneous multiprocessing technology which unlocks the power of all eight cores for outstanding performance with ultra-low power consumption and thermal control, as well as dual-channel LPDDR3 clocked at 933MHz for top-end memory bandwidth in a smartphone. MediaTek ClearMotion™ technology to eliminate motion jitter and ensure smooth video playback on mobile devices.

Source: https://www.mediatek.com/products/smartphones/mt6595

Processor

CPU Cluster 1:
ARM-A17 @ 2.5GHz

CPU Cluster 2:
ARM-A7 @ 1.7GHz

Source: https://www.mediatek.com/products/smartphones/mt6595

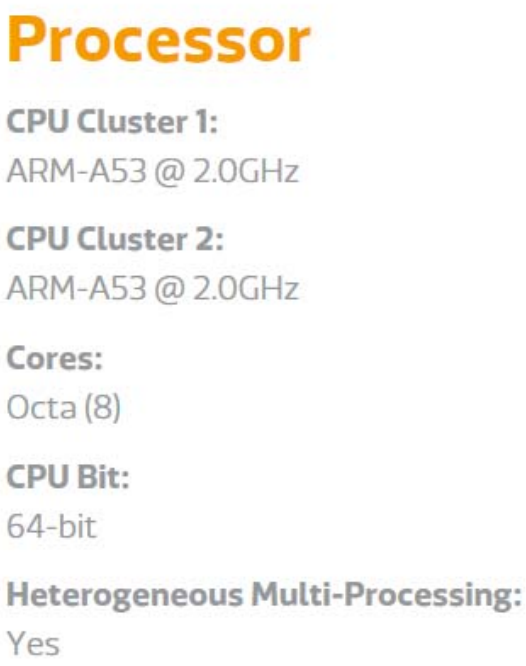
MediaTek Helio X10

64-bit true octa-core SoC with LTE and world's first 2K display support

MediaTek Helio X10 (MT6795) is a high-performance SoC which satisfies multimedia requirements of even the most demanding users, featuring multimedia subsystems that support many technologies never before possible or seen in a smartphone, including support for 120Hz displays and the capability to create and playback 480 frames per second (fps) 1080p Full HD Super-Slow Motion videos. MT6795 embeds a range of MediaTek technologies, including: MediaTek CorePilot™ heterogeneous multiprocessing technology which unlocks the power of all eight cores for outstanding performance with ultra-low power consumption and thermal control, as well as dual-channel LPDDR3 clocked at 933MHz for top-end memory bandwidth in a smartphone. MediaTek ClearMotion™ technology to eliminate motion jitter and ensure smooth video playback on mobile devices.

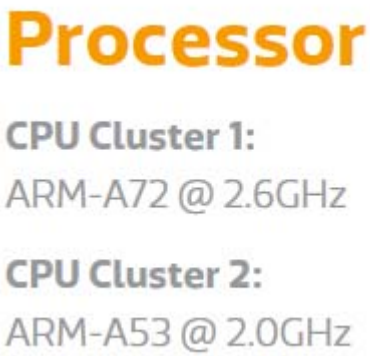
Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10

MT8783, MT8785, and MT8163), and Helio X series (including Helio X20, Helio X23, and Helio X25) families of products that include advanced on-chip service capabilities.



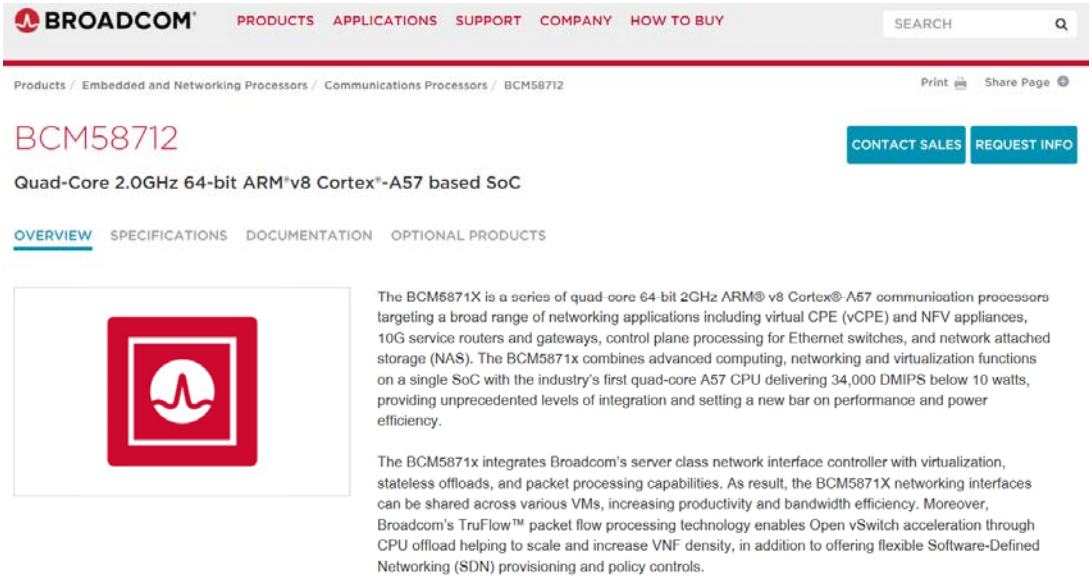
Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10

Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

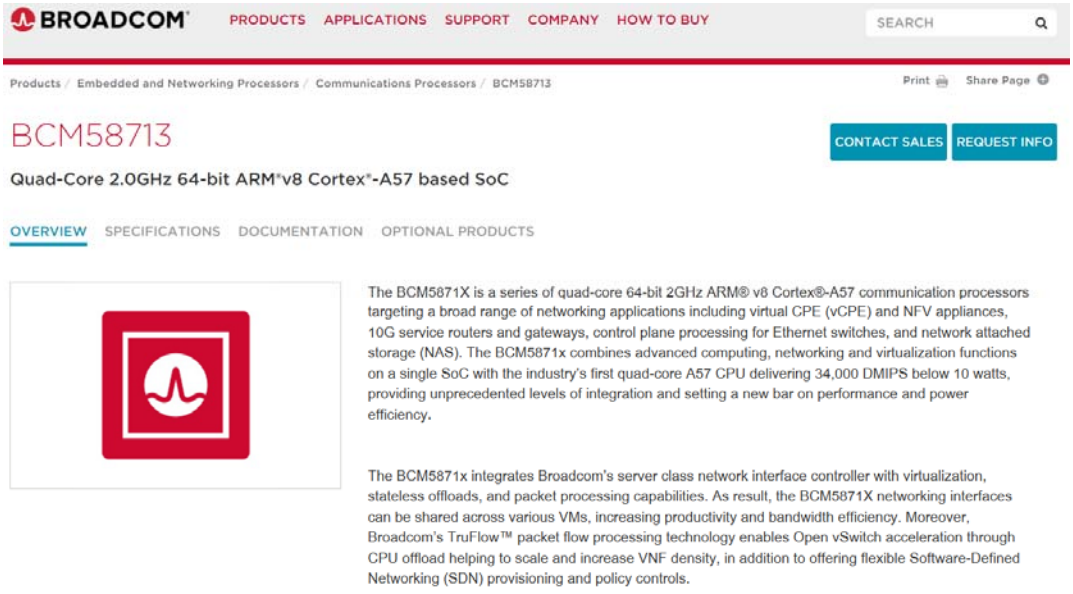


Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

91. Broadcom made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its BCM58712 and BCM58713 families of products that include advanced on-chip service capabilities ("accused products"):

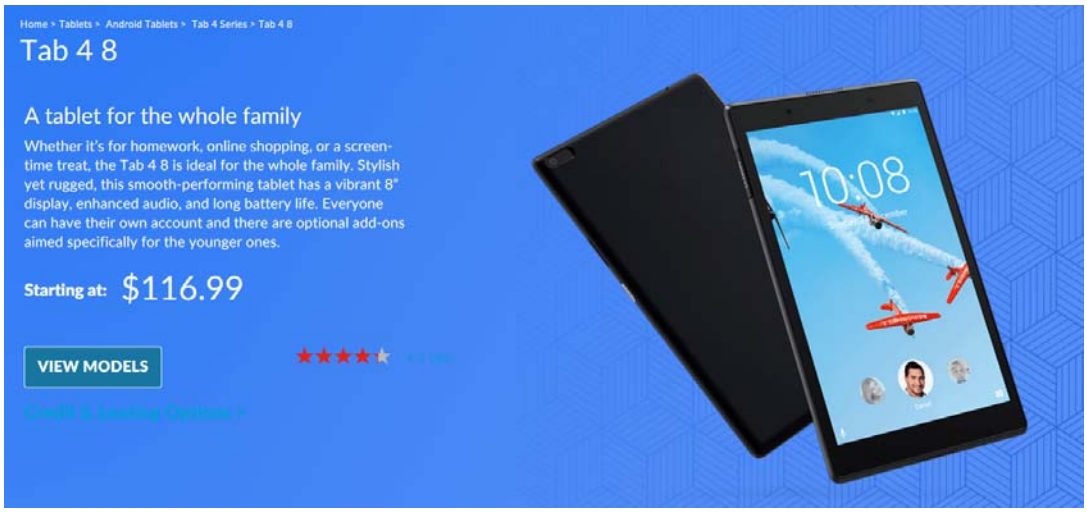


Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58712/



Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58713/

92. Lenovo made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Lenovo Tab 4 8, Lenovo Tab 4 10, and Lenovo Tab 3 10 families of products that include advanced on-chip service capabilities ("accused products"):



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

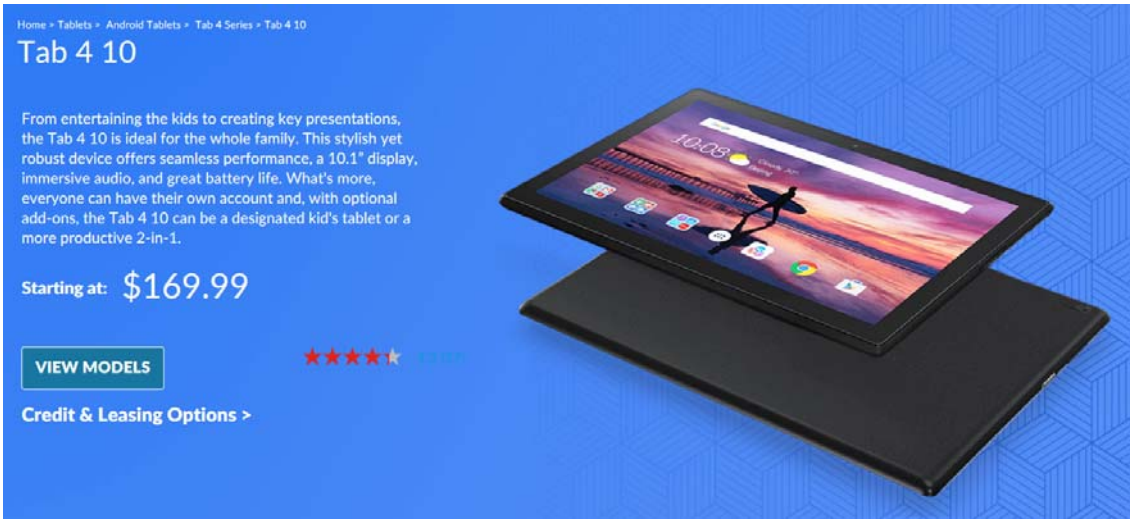
Processor	Qualcomm® Snapdragon™ MSM8917 Processor (1.4 GHz)
Operating System	Android™ Nougat 7.1

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

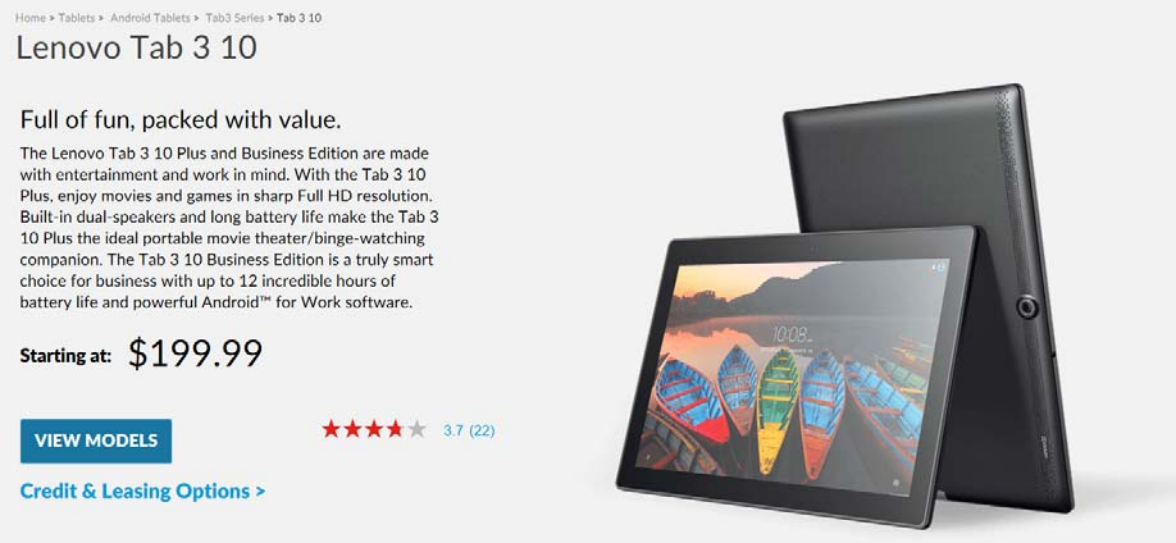
Processor	Qualcomm® Snapdragon™ APQ8017 Processor (1.40GHz)

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

Processor	MediaTek™ 8161 Quad-Core Processor (1.30GHz 1MB)

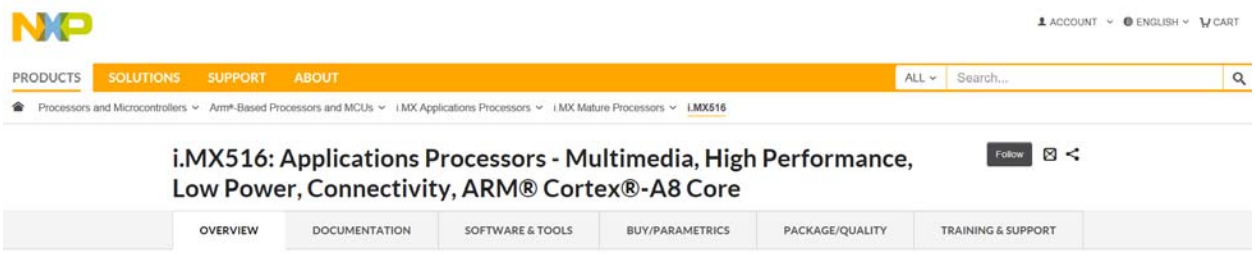
Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

> The MediaTek MT8161 is an ARM based entry-level to mid-range SoC for (Android based) tablets. It offers four ARM Cortex-A53 processor cores (quad-core) that are clocked with up to 1.3 GHz. Furthermore, an ARM Mali-720 graphics card, a LPDDR3 memory controller (e.g., accessing 1 GB in the Lenovo Tab 2 A8-50), Bluetooth 4.0 and dual-band 802.11 b/g/n are integrated in the SoC.

Source: https://www.notebookcheck.net/Mediatek-MT8161-Tablet-SoC.145089.0.html

93. NXP made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its i.MX516, S32V234,

and i.MX 8QuadMax families of products that include advanced on-chip service capabilities ("accused products")[8]:



Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-mature-processors/applications-processors-multimedia-high-performance-low-power-connectivity-arm-cortex-a8-core:i.MX516

Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/s32-automotive-platform/vision-processor-for-front-and-surround-view-camera-machine-learning-and-sensor-fusion-applications:S32V234

[8] A non-exhaustive list of additional accused products includes the i.MX 7 series, i.MX 8 series, i.MX Mature series, QorIQ Layerscape series, i.MX534, i.MX535, i.MX537, i.MX8M, and i.MX 8QuadPlus families of products that include advanced on-chip service capabilities.

Feature	i.MX 8QuadMax	i.MX 8QuadPlus
ARM® Core	2 x ARM Cortex®-A72	1 x Cortex-A72
ARM Core	4 x Cortex-A53	4 x Cortex-A53
ARM Core	2 x Cortex-M4F	2 x Cortex-M4F

Source: fact sheet downloaded from https://www.nxp.com/docs/en/fact-sheet/IMX8FAMFS.pdf

94. Qualcomm made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Snapdragon 410E and Snapdragon 650 families of products that include advanced on-chip service capabilities ("accused products")[9]:

> Designed to meet the demanding requirements of embedded computing applications with its high performance, energy efficiency, multimedia features, integrated connectivity and long-term support, the Qualcomm® Snapdragon™ 410E embedded platform is an ideal platform for the Internet of Things.

Source: https://www.qualcomm.com/products/apq8016e

CPU	CPU Clock Speed: Up to 1.2 GHz CPU Cores: Quad-core CPU, 4x ARM Cortex A53 CPU Bit Architecture: 64-bit, 32-bit

Source: https://www.qualcomm.com/products/apq8016e

[9] A non-exhaustive list of additional accused products includes the Snapdragon 400 tier (including Snapdragon 439 (SDM439), Snapdragon 450, Snapdragon 427 (MSM8920), and Snapdragon 435 (MSM8940)), MSM8956, the Snapdragon 600 tier (including Snapdragon 652 (MSM8976), and Snapdragon 653 (MSM8976 Pro)) families of products that include advanced on-chip service capabilities.

Snapdragon 650 Mobile Platform

The Qualcomm® Snapdragon™ 650 mobile platform supports high-quality, efficient performance, multimedia, gaming and connectivity, thanks to its powerful 64-bit capable hexa-core CPUs, integrated Qualcomm® Snapdragon™ X8 LTE with Cat 7 speeds, Qualcomm® Adreno™ 510 GPU, and support for 4K Ultra HD video.

Source: https://www.qualcomm.com/products/snapdragon/processors/650

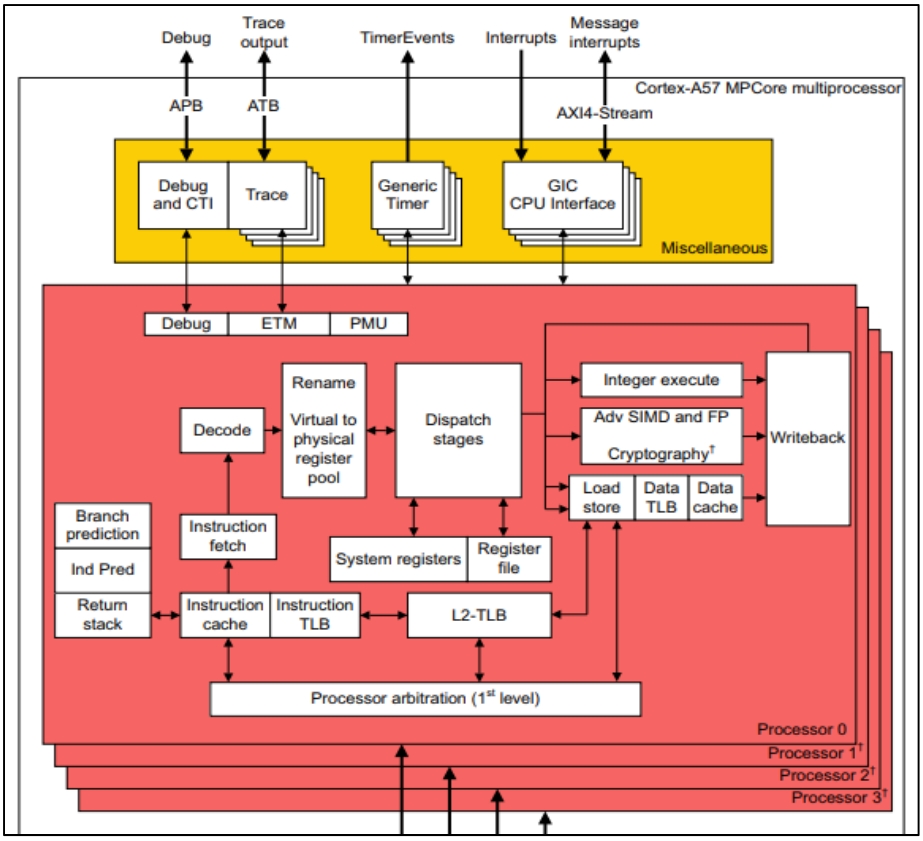
CPU	CPU Clock Speed: Up to 1.8 GHz CPU Cores: Hexa-core CPU, 2x ARM Cortex A72, 4x ARM Cortex A53 CPU Bit Architecture: 64-bit

Source: https://www.qualcomm.com/products/snapdragon/processors/650

95. By doing so, Defendants have directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '716 Patent. Defendants' infringement in this regard is ongoing.

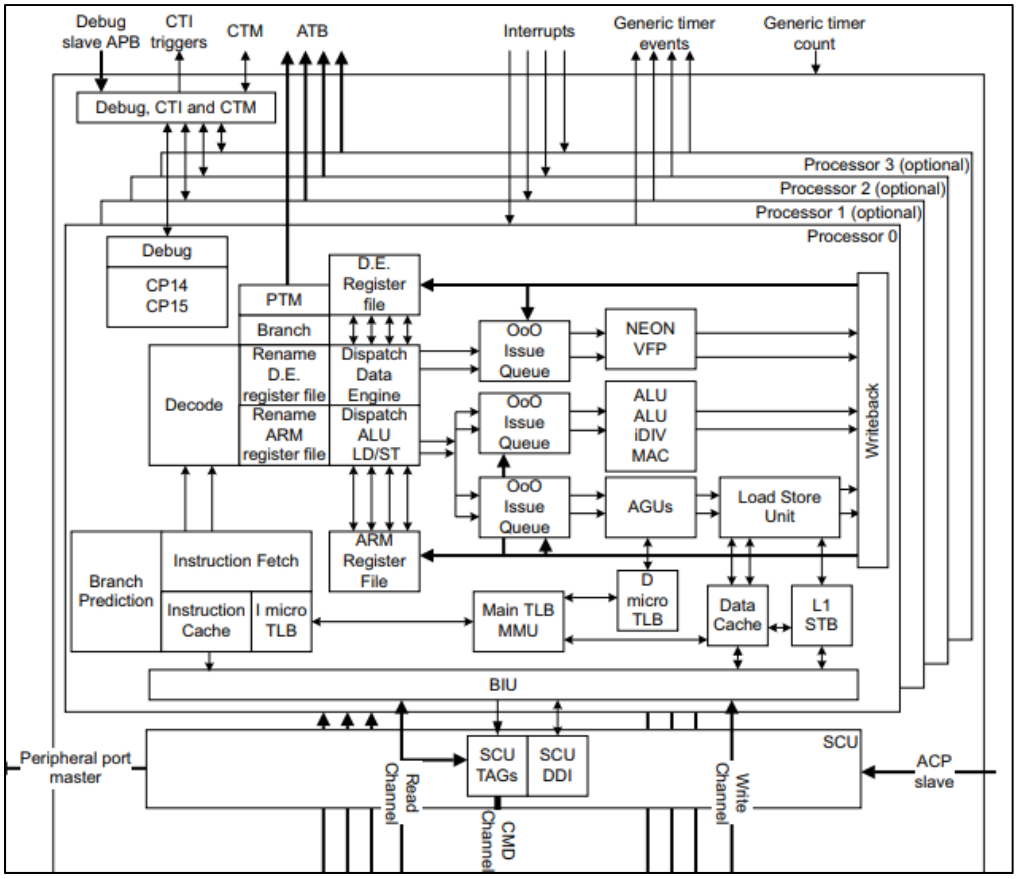
96. Defendants have infringed the '716 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale integrated circuits having advanced on-chip service capabilities.

97. The accused products include one or more logic blocks to generate one or more system operation signals at one or more system operation clock rates.



Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf



Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

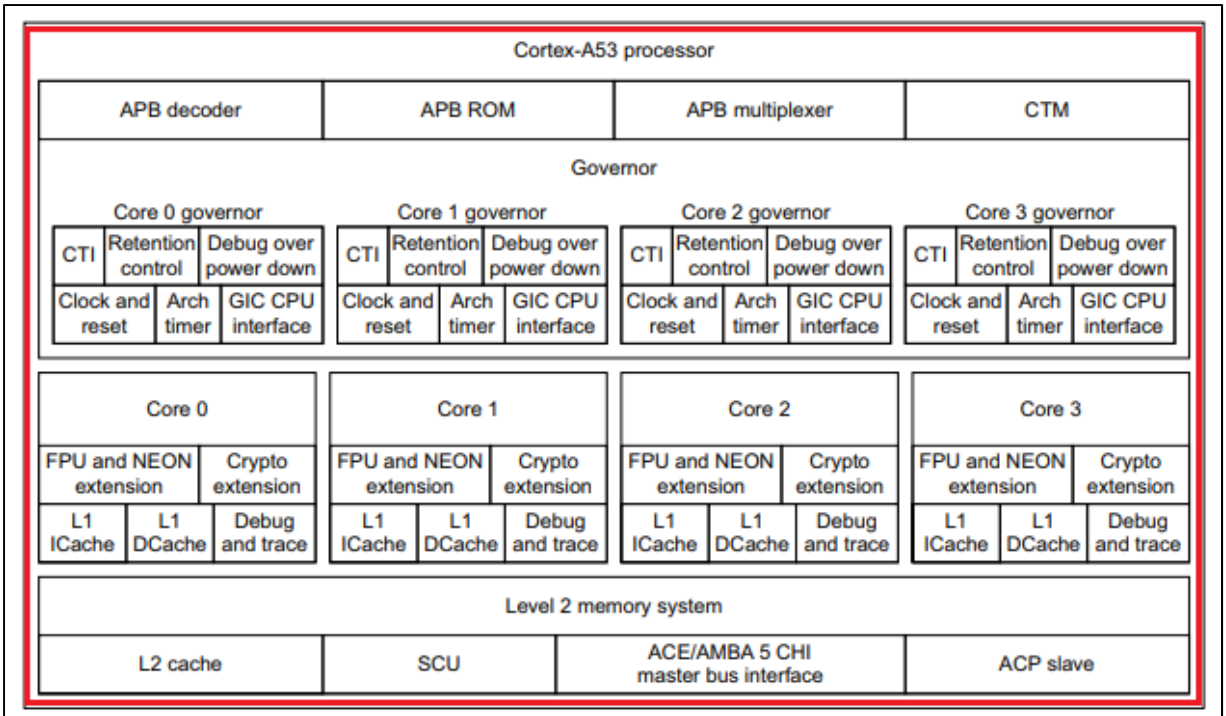
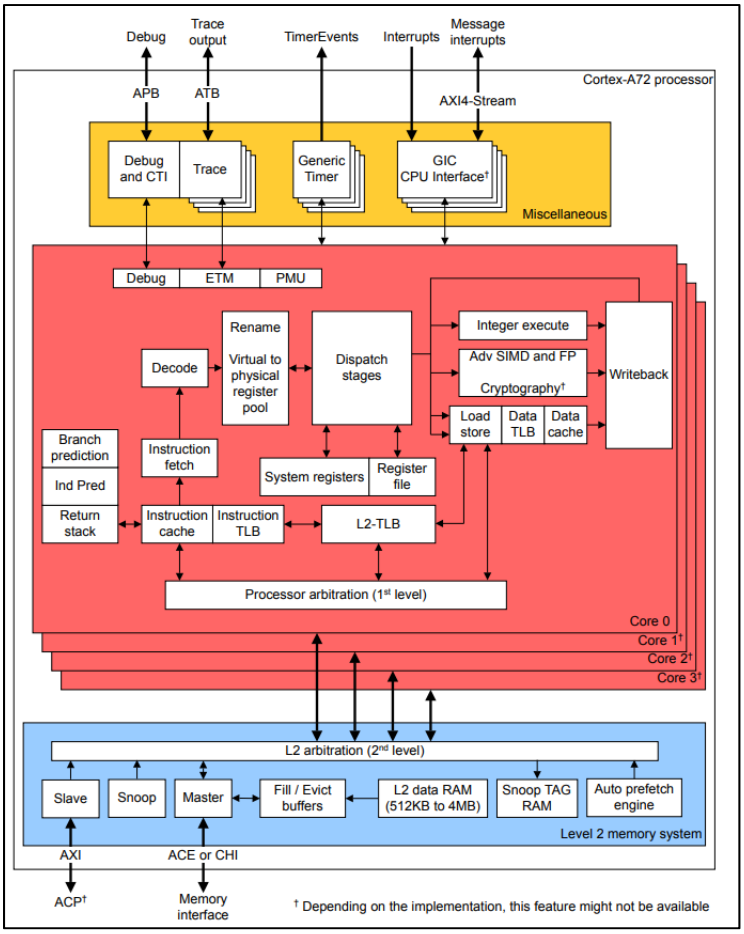


Figure 2-1 Cortex-A53 processor block diagram

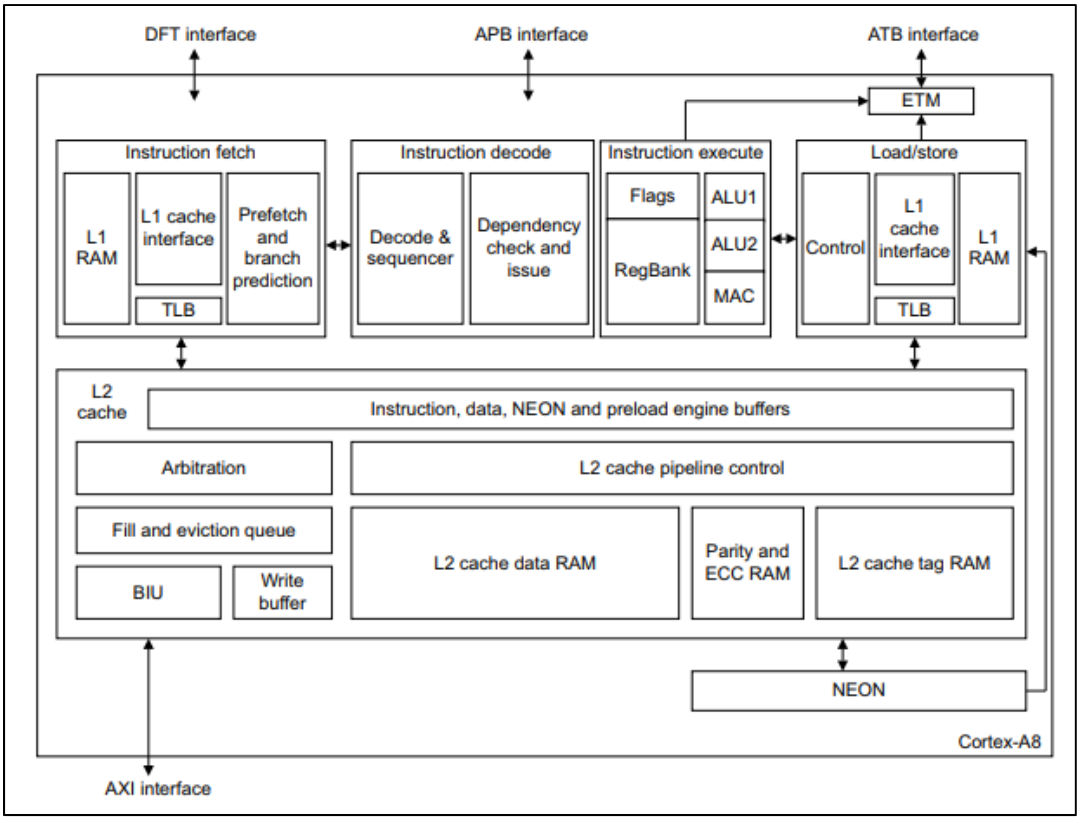
Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf



Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf



Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf

98. The accused products include a service processor unit configured to perform one or more debug operations on one or more of said logic blocks.

Embedded Trace Macrocell architecture

The multiprocessor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

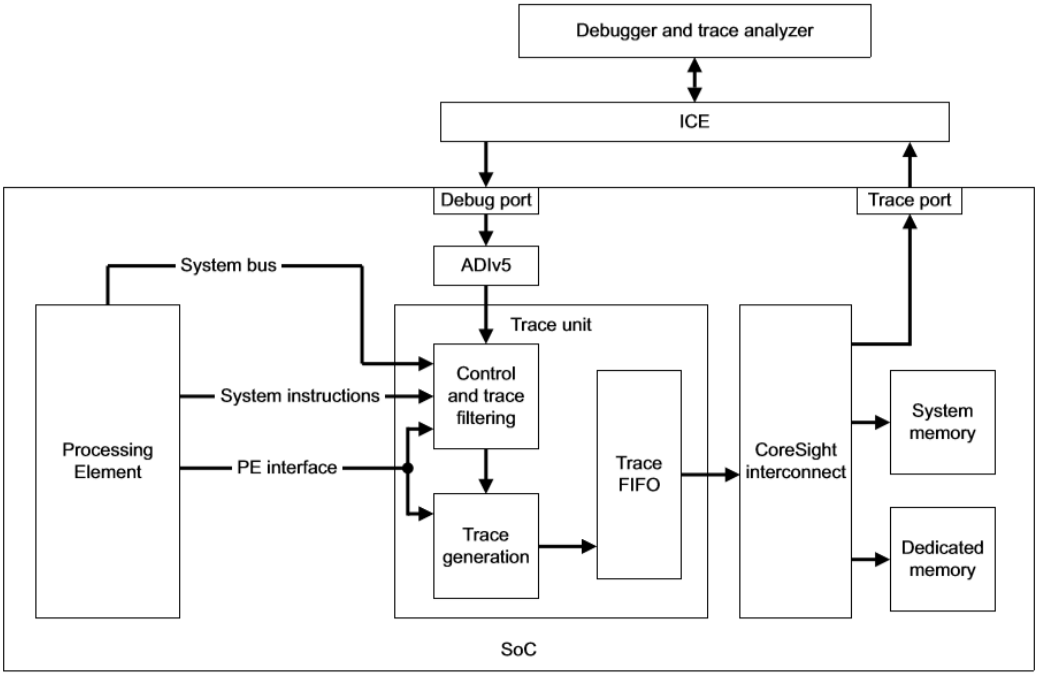


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

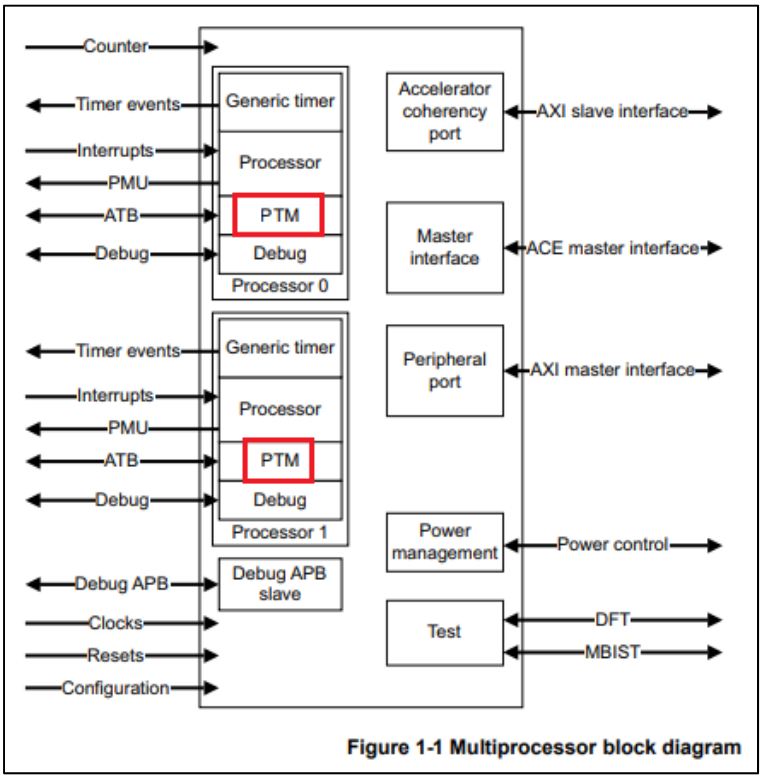


Figure 1-1 Multiprocessor block diagram

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

The PTM is a real-time instruction flow trace module that complies with the *Program Flow Trace* (PFTv1.1) architecture. The PTM is a CoreSight component, and is an integral part of the ARM Real-time Debug solution, DS-5.

For more information see:

- *ARM® CoreSight™ Architecture Specification* (ARM IHI 0029).
- *ARM® CoreSight™ SoC Technical Reference Manual* (ARM DDI 0480).

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

Embedded Trace Macrocell architecture

The Cortex-A53 processor implements the ETMv4 architecture. See the *ARM® ETM™ Architecture Specification, ETMv4*.

Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf

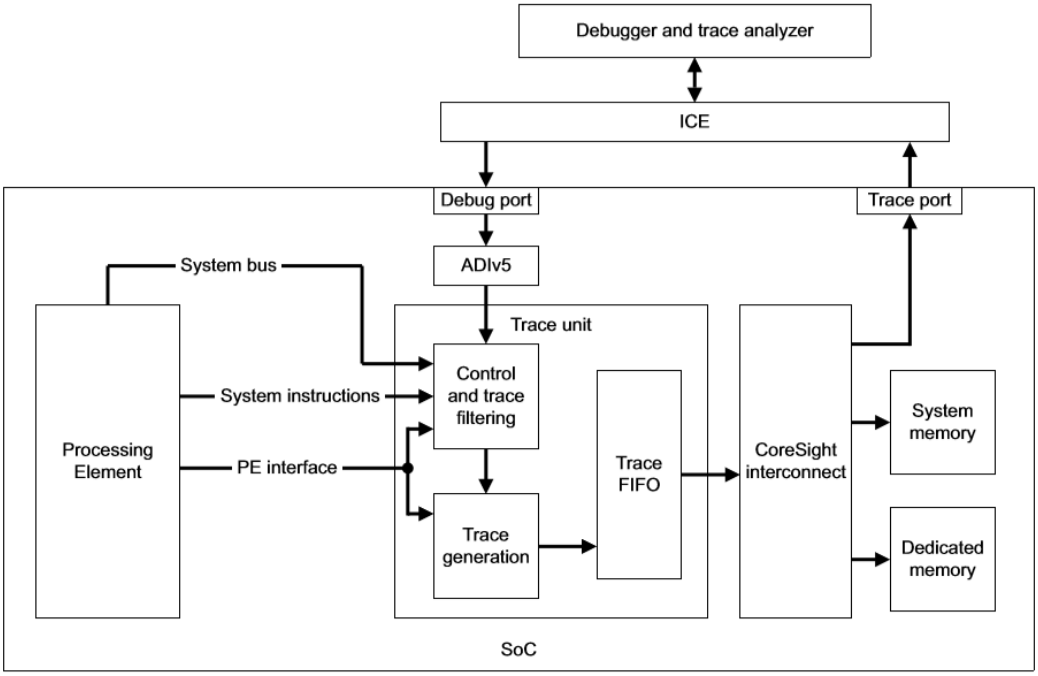


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

Embedded Trace Macrocell architecture

The processor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf

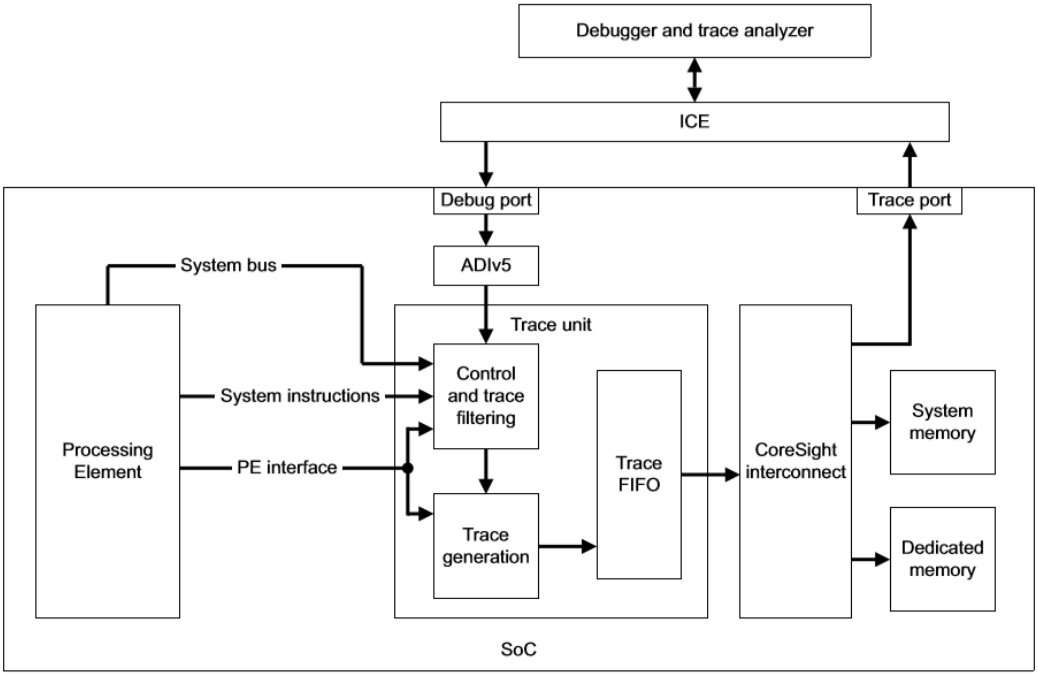


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

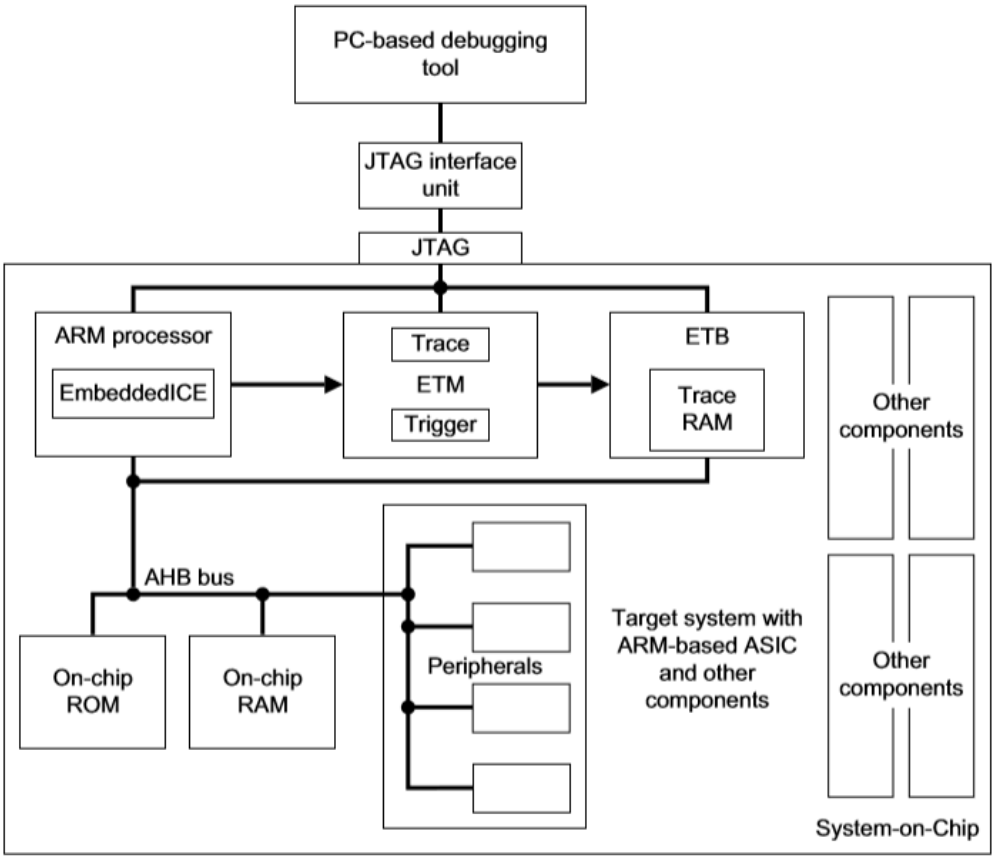
https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

About the ETM

The ETM is a CoreSight™ component designed for use with the CoreSight Design Kit. CoreSight is the ARM extensible, system-wide debug and trace architecture. The Cortex-A8 processor implements the ETM architecture v3.3.

Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf



Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

About controlling tracing

You control tracing in two ways:

Triggering Triggering controls when the collection of the trace data occurs. Setting a trigger enables you to focus trace collection around your region of interest.

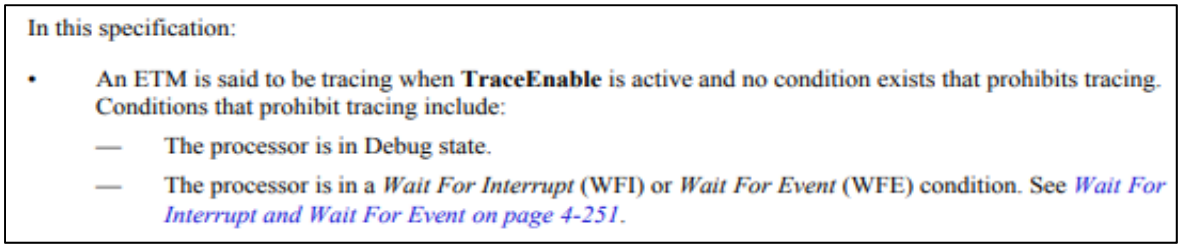
Filtering Filtering controls the type of trace information that is collected. It is important to optimize usage of the trace port bandwidth, especially when a narrow trace port is used. Filtering the trace serves two purposes:

- It prevents overflow of the internal FIFO by minimizing the number of data transfers traced. This is especially important when the FIFO is small or the trace port is narrow.
- It limits the amount of trace stored by the *trace capture device* (TCD), for example a TPA or an on-chip trace buffer. This enables more useful information to be stored around the trigger.

You can filter the instruction trace or the data trace as follows:

- Filter the instruction trace by enabling and disabling trace generation. This is the **TraceEnable** function.
- Filter the data trace by indicating the specific data accesses that must be traced. This is the **ViewData** function.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf



In this specification:

- An ETM is said to be tracing when **TraceEnable** is active and no condition exists that prohibits tracing. Conditions that prohibit tracing include:
  - The processor is in Debug state.
  - The processor is in a *Wait For Interrupt* (WFI) or *Wait For Event* (WFE) condition. See *Wait For Interrupt and Wait For Event on page 4-251*.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

99. The service processor unit of the accused products includes a control unit, a buffer memory, an analysis engine, and a bus interface.

100. The accused products include a multiplicity of probe lines configured to capture and propagate one or more of said one or more system operation signals from said logic blocks to said service processor unit during normal system operation.

101. The accused products include said analysis engine configured to align signals received from said probe lines during normal system operation.

102. Defendants have had knowledge of the '716 Patent at least as of the date when they were notified of the filing of this action.

103. On November 23, 2005, the great-great-grandparent of the '716 Patent (U.S. Patent No. 6,687,865) was cited by the Examiner during prosecution of U.S. Patent No. 7,567,892, which is assigned to Broadcom Corp. The Examiner in that prosecution explained that the great-great-grandparent of the '716 Patent was pertinent because "Dervisoglu et al. (U.S. Patent No. 6,687,865) discloses an on-chip service processor for testing and debugging of integrated circuits." Broadcom employees Geoff Barrett, Simon Christopher Dequin Clemow, and Andrew Jon Dawson, who are listed as inventors on U.S. Patent No. 7,567,892, Robert

Sokohl, Jeffrey S. Weaver, and others involved in the prosecution of the patent, have had knowledge of the '716 Patent well before this suit was filed.

104. On March 6, 2006, the great-great grandparent of the '716 Patent (U.S. Patent No. 6,687,865) was cited in an IDS during prosecution of U.S. Patent No. 7,533,315, which is assigned to Mediatek Inc. During that same prosecution, the Examiner also cited the grandparent of the '716 Patent (U.S. Patent No. 7,080,301) on June 18, 2008. MediaTek employees I-Chieh Han and You-Ming Chiu, who are listed as inventors on U.S. Patent No. 7,533,315, Daniel R. McClure, and others involved in the prosecution of the patent, have had knowledge of the '716 Patent well before this suit was filed.

105. American Patents has been damaged as a result of the infringing conduct by Defendants alleged above. Thus, Defendants are liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

106. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '716 Patent.

COUNT IV

DIRECT INFRINGEMENT OF U.S. PATENT NO. 8,996,938

107. On March 31, 2015, United States Patent No. 8,996,938 ("the '938 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "On-Chip Service Processor."

108. American Patents is the owner of the '938 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '938 Patent against infringers, and to collect damages for all relevant times.

109. MediaTek made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its MT6595, Helio X10, and Helio X27 families of products that include advanced on-chip service capabilities ("accused products") [10]:

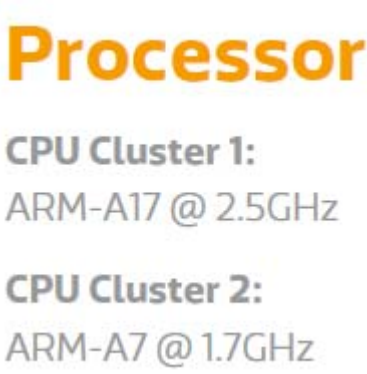
MT6595

The world's first octa-core 4G LTE smartphone chip with the new ARM Cortex-A17 processor

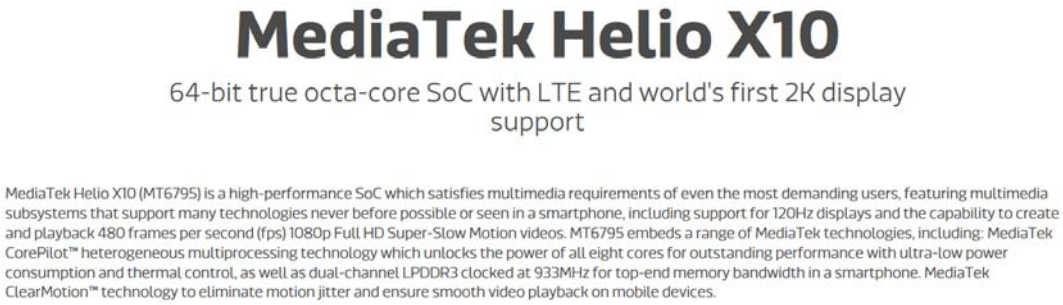
MediaTek MT6795 is a high-performance SoC which satisfies multimedia requirements of even the most demanding users, featuring multimedia subsystems that support many technologies never before possible or seen in a smartphone, including support for 120Hz displays and the capability to create and playback 480 frames per second (fps) 1080p Full HD Super-Slow Motion videos. MT6595 embeds a range of MediaTek technologies, including: MediaTek CorePilot™ heterogeneous multiprocessing technology which unlocks the power of all eight cores for outstanding performance with ultra-low power consumption and thermal control, as well as dual-channel LPDDR3 clocked at 933MHz for top-end memory bandwidth in a smartphone. MediaTek ClearMotion™ technology to eliminate motion jitter and ensure smooth video playback on mobile devices.

Source: https://www.mediatek.com/products/smartphones/mt6595

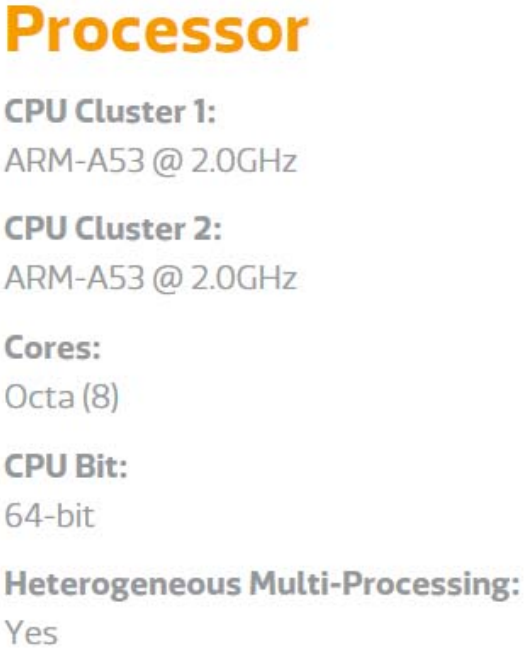
[10] A non-exhaustive list of additional accused products includes the MT6739, MT6750, MT6752, MT6753, Helio P, Helio A22, MT7622, MT7623, MT8x series (including MT8173, MT8176, MT8783, MT8785, and MT8163), and Helio X series (including Helio X20, Helio X23, and Helio X25) families of products that include advanced on-chip service capabilities.



Source: https://www.mediatek.com/products/smartphones/mt6595

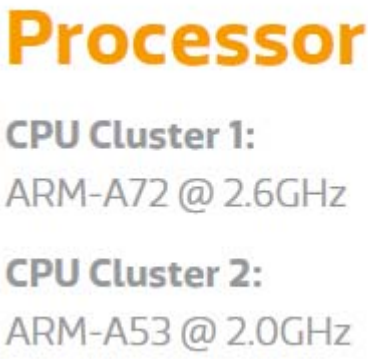


Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10



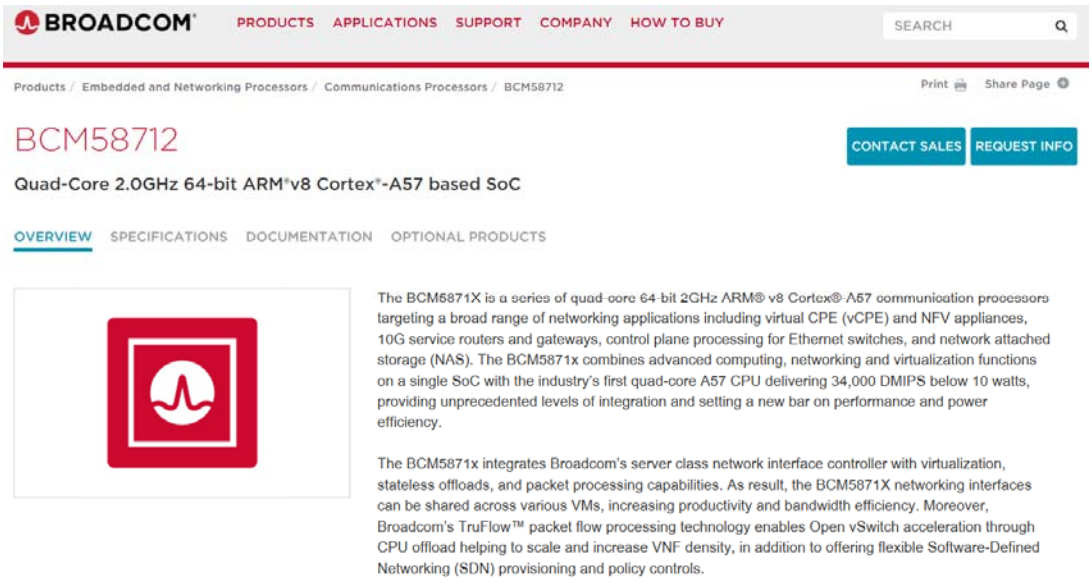
Source: https://www.mediatek.com/products/smartphones/mt6795-helio-x10

Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

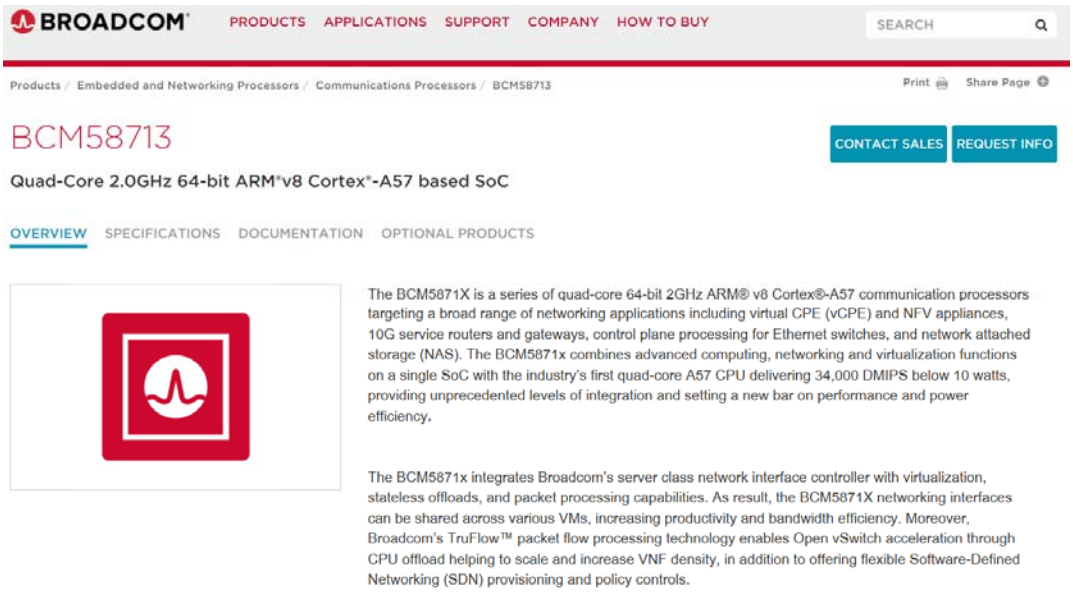


Source: https://www.mediatek.com/products/smartphones/mt6797x-helio-x27

110. Broadcom made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its BCM58712 and BCM58713 families of products that include advanced on-chip service capabilities ("accused products"):

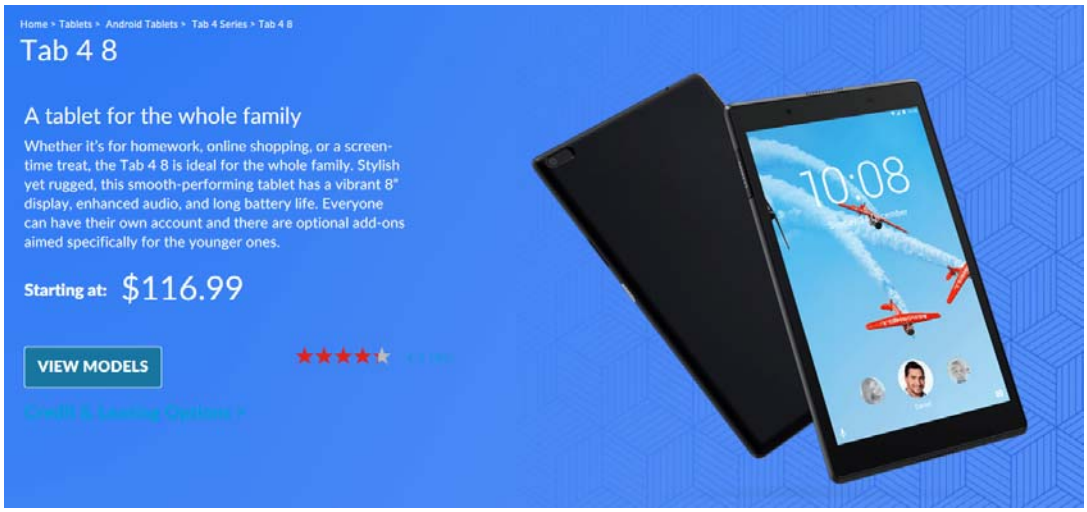


Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58712/



Source: https://www.broadcom.com/products/embedded-and-networking-processors/communications/bcm58713/

111. Lenovo made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Lenovo Tab 4 8, Lenovo Tab 4 10, and Lenovo Tab 3 10 families of products that include advanced on-chip service capabilities ("accused products"):



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

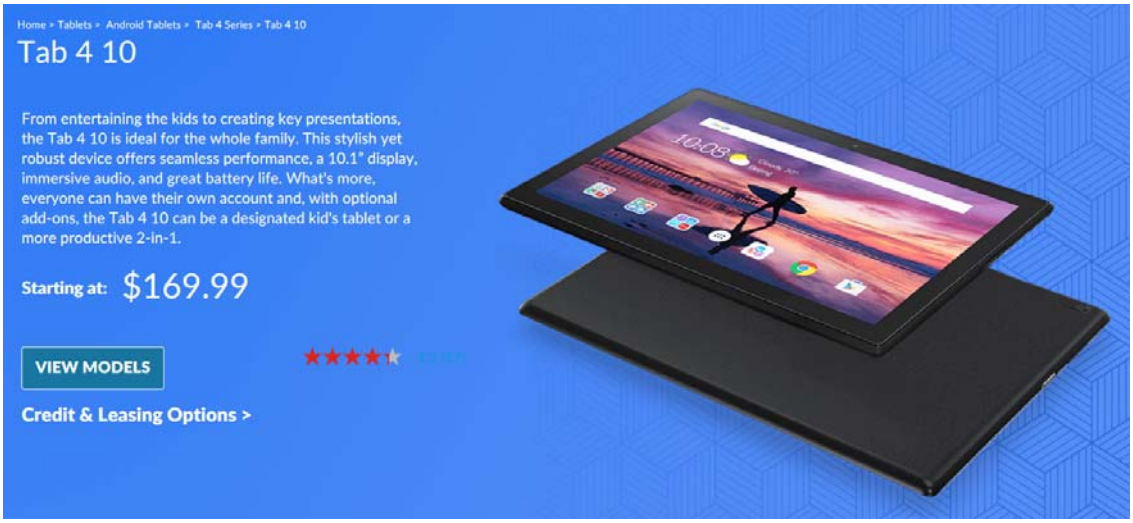
Processor	Qualcomm® Snapdragon™ MSM8917 Processor (1.4 GHz)
Operating System	Android™ Nougat 7.1

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-8504/p/ZZITZTATB08

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

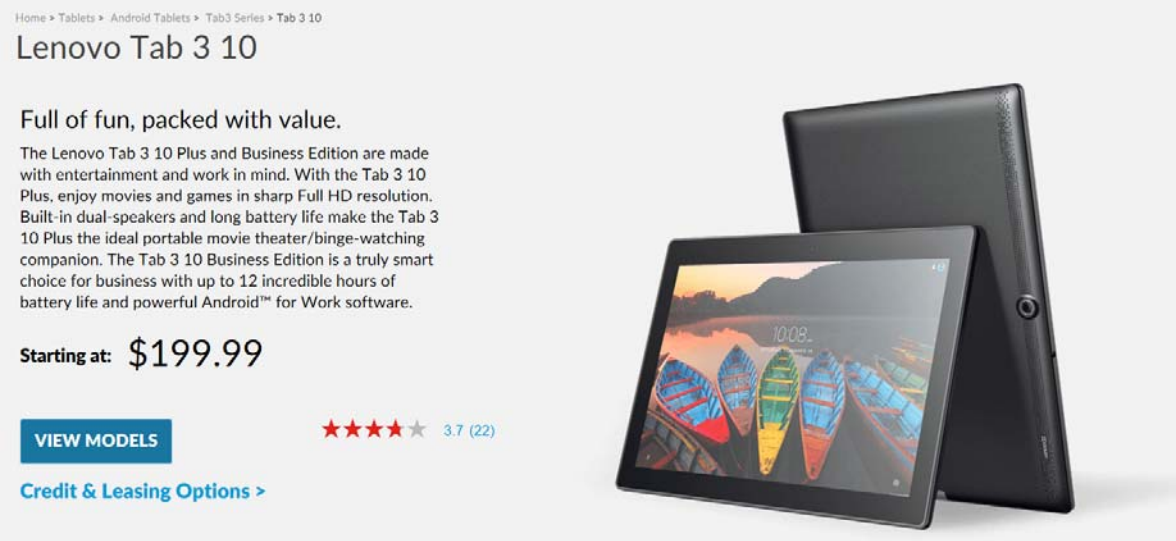
Processor	Qualcomm® Snapdragon™ APQ8017 Processor (1.40GHz)

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab-4-series/Lenovo-TB-X304/p/ZZITZTATB0X

CPU Cores

- Quad-core CPU
- 4x ARM Cortex A53

Source: https://www.qualcomm.com/products/snapdragon/processors/425



Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

Processor	MediaTek™ 8161 Quad-Core Processor (1.30GHz 1MB)

Source: https://www.lenovo.com/us/en/tablets/android-tablets/tab3-series/Lenovo-Tab-3-10-Business/p/ZZITZTATB2F

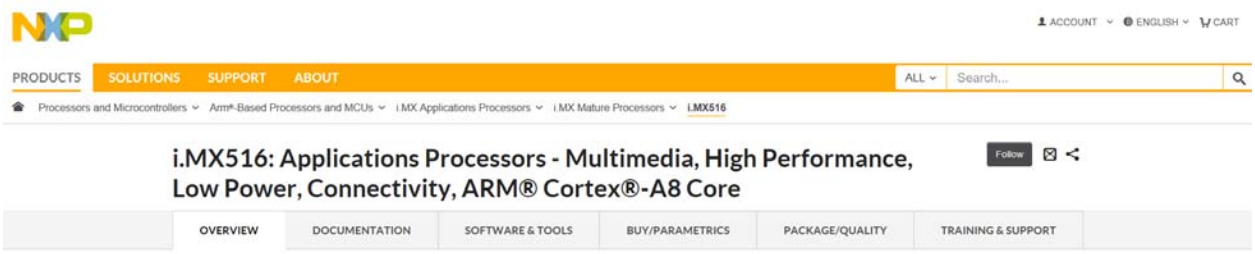
> The MediaTek MT8161 is an ARM based entry-level to mid-range SoC for (Android based) tablets. It offers four ARM Cortex-A53 processor cores (quad-core) that are clocked with up to 1.3 GHz. Furthermore, an ARM Mali-720 graphics card, a LPDDR3 memory controller (e.g., accessing 1 GB in the Lenovo Tab 2 A8-50), Bluetooth 4.0 and dual-band 802.11 b/g/n are integrated in the SoC.

Source: https://www.notebookcheck.net/Mediatek-MT8161-Tablet-SoC.145089.0.html

112. NXP made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its i.MX516, S32V234,

and i.MX 8QuadMax families of products that include advanced on-chip service capabilities

("accused products") [11]:



Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-mature-processors/applications-processors-multimedia-high-performance-low-power-connectivity-arm-cortex-a8-core:i.MX516

Source: https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/s32-automotive-platform/vision-processor-for-front-and-surround-view-camera-machine-learning-and-sensor-fusion-applications:S32V234

[11] A non-exhaustive list of additional accused products includes the i.MX 7 series, i.MX 8 series, i.MX Mature series, QorIQ Layerscape series, i.MX534, i.MX535, i.MX537, i.MX8M, and i.MX 8QuadPlus families of products that include advanced on-chip service capabilities.

Feature	i.MX 8QuadMax	i.MX 8QuadPlus
ARM® Core	2 x ARM Cortex®-A72	1 x Cortex-A72
ARM Core	4 x Cortex-A53	4 x Cortex-A53
ARM Core	2 x Cortex-M4F	2 x Cortex-M4F

Source: fact sheet downloaded from https://www.nxp.com/docs/en/fact-sheet/IMX8FAMFS.pdf

113. Qualcomm made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Snapdragon 410E and Snapdragon 650 families of products that include advanced on-chip service capabilities ("accused products") [12]:

> Designed to meet the demanding requirements of embedded computing applications with its high performance, energy efficiency, multimedia features, integrated connectivity and long-term support, the Qualcomm® Snapdragon™ 410E embedded platform is an ideal platform for the Internet of Things.

Source: https://www.qualcomm.com/products/apq8016e

CPU

CPU Clock Speed: Up to 1.2 GHz
CPU Cores: Quad-core CPU, 4x ARM Cortex A53
CPU Bit Architecture: 64-bit, 32-bit

Source: https://www.qualcomm.com/products/apq8016e

[12] A non-exhaustive list of additional accused products includes the Snapdragon 400 tier (including Snapdragon 439 (SDM439), Snapdragon 450, Snapdragon 427 (MSM8920), and Snapdragon 435 (MSM8940)), MSM8956, the Snapdragon 600 tier (including Snapdragon 652 (MSM8976), and Snapdragon 653 (MSM8976 Pro)) families of products that include advanced on-chip service capabilities.

Snapdragon 650 Mobile Platform

The Qualcomm® Snapdragon™ 650 mobile platform supports high-quality, efficient performance, multimedia, gaming and connectivity, thanks to its powerful 64-bit capable hexa-core CPUs, integrated Qualcomm® Snapdragon™ X8 LTE with Cat 7 speeds, Qualcomm® Adreno™ 510 GPU, and support for 4K Ultra HD video.

Source: https://www.qualcomm.com/products/snapdragon/processors/650

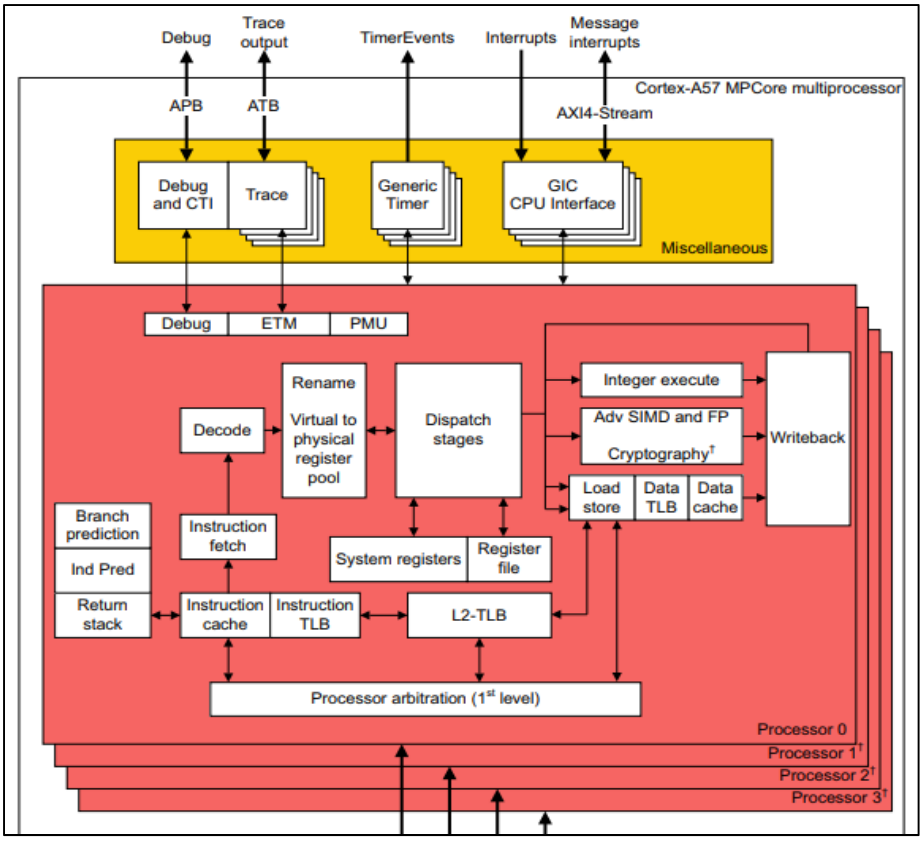
CPU	CPU Clock Speed: Up to 1.8 GHz CPU Cores: Hexa-core CPU, 2x ARM Cortex A72, 4x ARM Cortex A53 CPU Bit Architecture: 64-bit

Source: https://www.qualcomm.com/products/snapdragon/processors/650

114. By doing so, Defendants have directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '938 Patent. Defendants' infringement in this regard is ongoing.

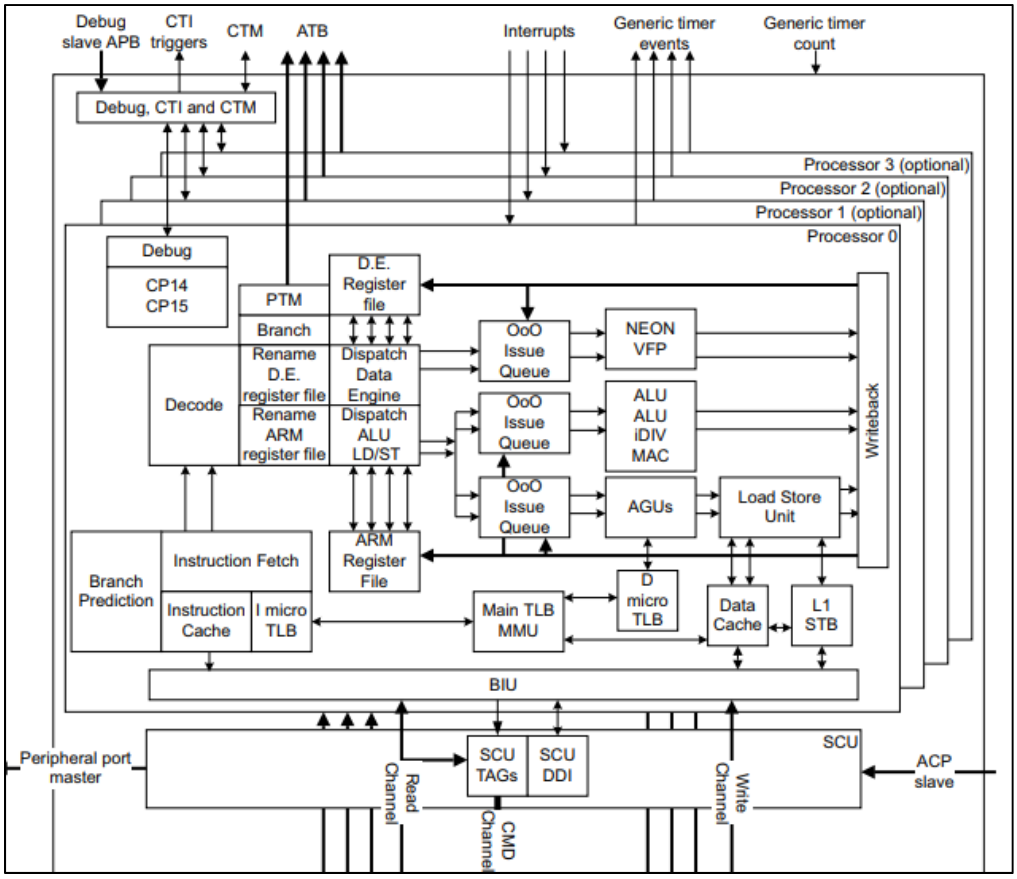
115. Defendants have infringed the '938 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale integrated circuits having advanced on-chip service capabilities.

116. The accused products include one or more logic blocks configured to generate one or more system operation signals at one or more system operation clock rates.



Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf



Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

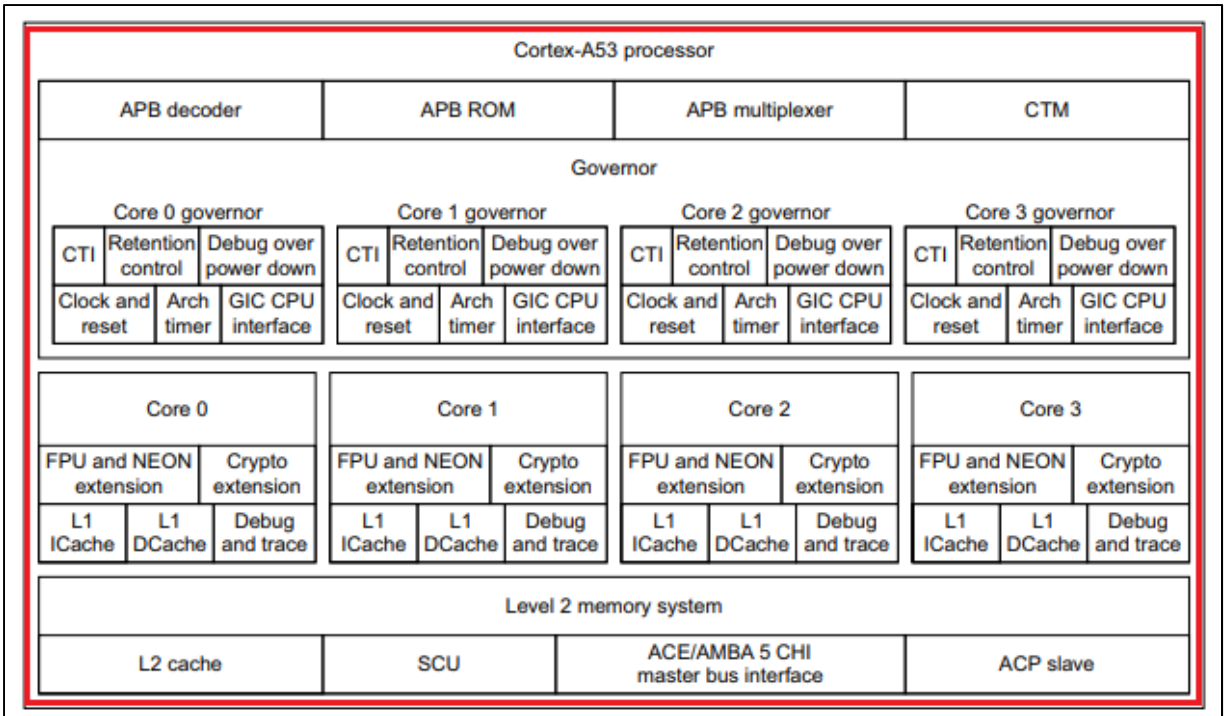
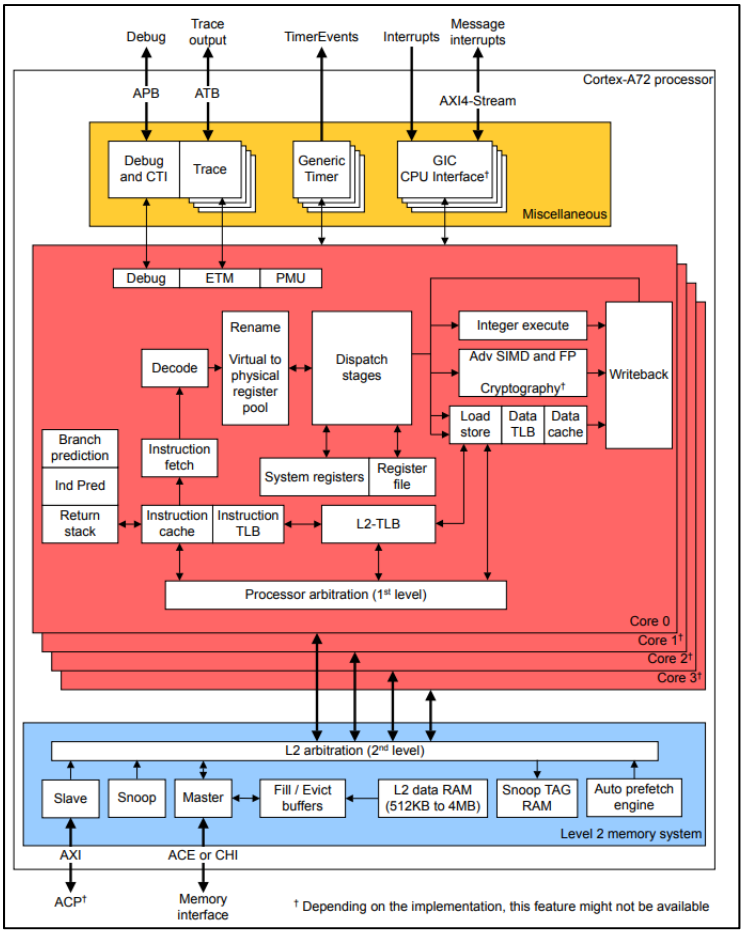


Figure 2-1 Cortex-A53 processor block diagram

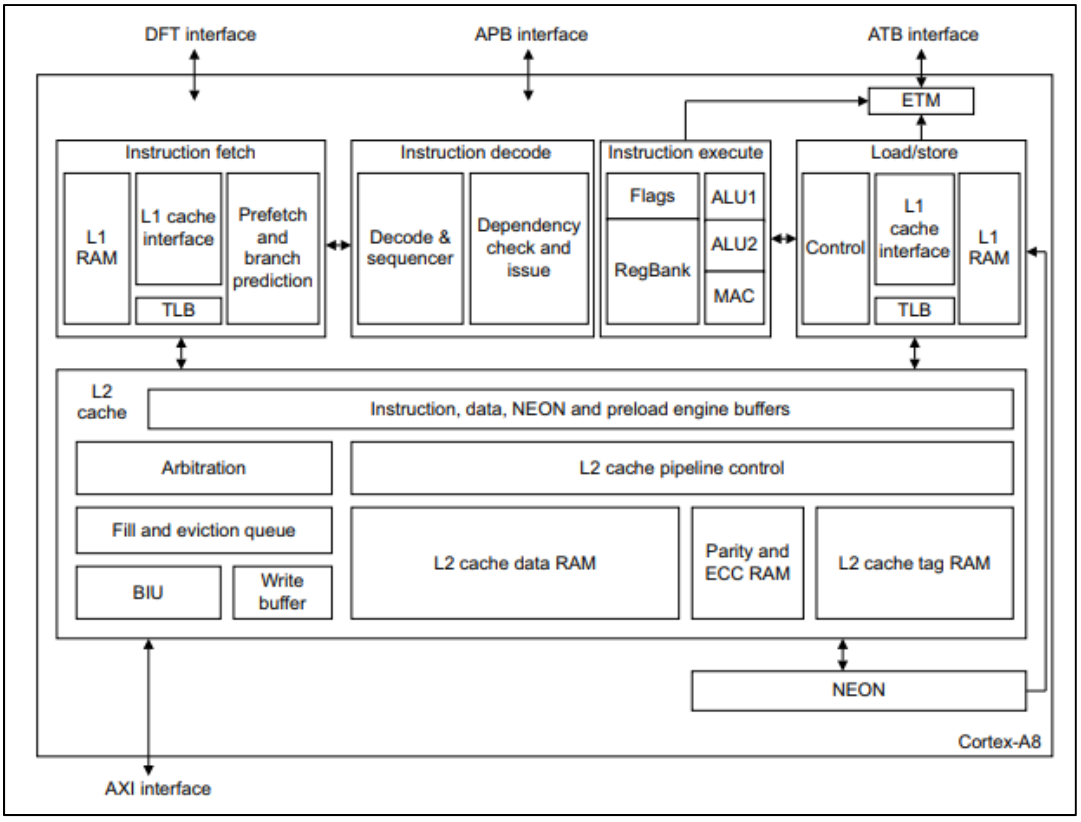
Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf



Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf



Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf

117. The accused products include a service processor unit configured to perform one or more debug operations on one or more of said logic blocks.

Embedded Trace Macrocell architecture

The multiprocessor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A57 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0488c/DDI0488C_cortex_a57_mpcore_r1p0_trm.pdf

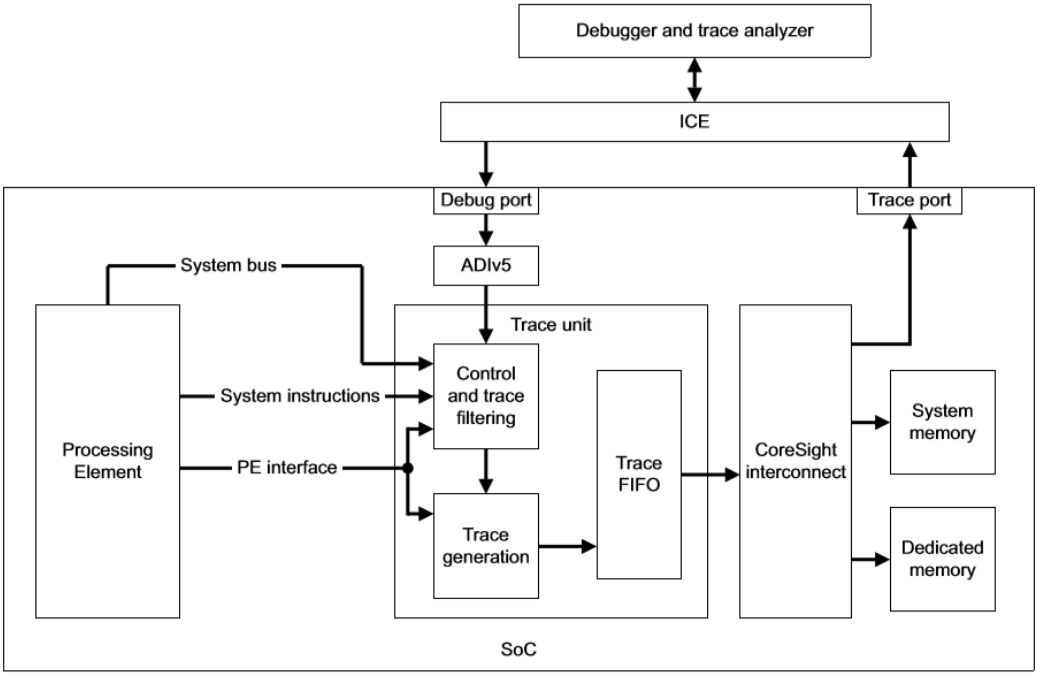


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

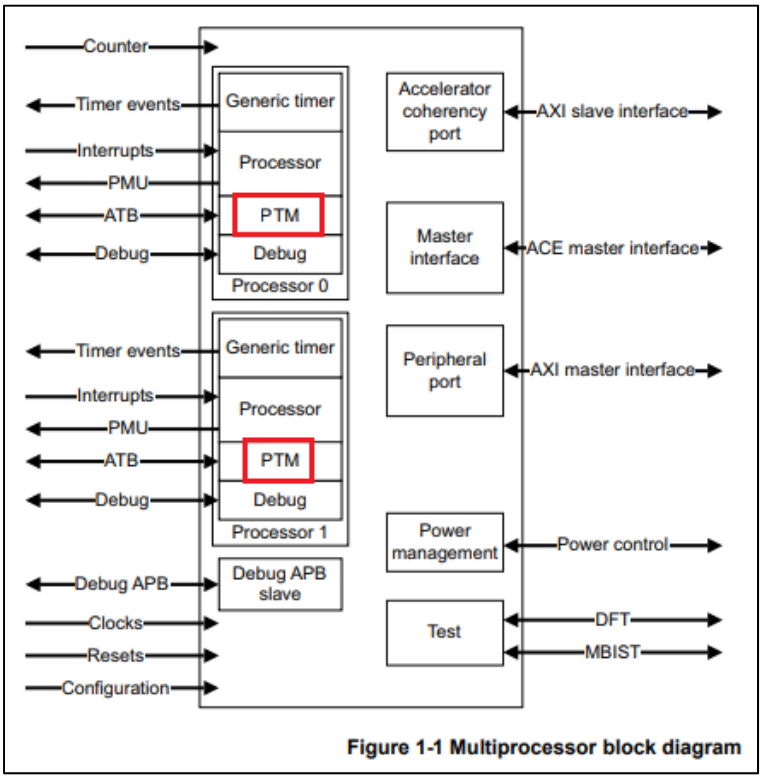


Figure 1-1 Multiprocessor block diagram

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

> The PTM is a real-time instruction flow trace module that complies with the *Program Flow Trace* (PFTv1.1) architecture. The PTM is a CoreSight component, and is an integral part of the ARM Real-time Debug solution, DS-5.
>
> For more information see:
> - *ARM® CoreSight™ Architecture Specification* (ARM IHI 0029).
> - *ARM® CoreSight™ SoC Technical Reference Manual* (ARM DDI 0480).

Source: ARM Cortex-A17 MPCore Processor manual downloaded from

https://static.docs.arm.com/ddi0535/b/DDI0535B_cortex_a17_r1p0_trm.pdf

> **Embedded Trace Macrocell architecture**
>
> The Cortex-A53 processor implements the ETMv4 architecture. See the *ARM® ETM™ Architecture Specification, ETMv4*.

Source: ARM Cortex-A53 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.ddi0500d/DDI0500D_cortex_a53_r0p2_trm.pdf

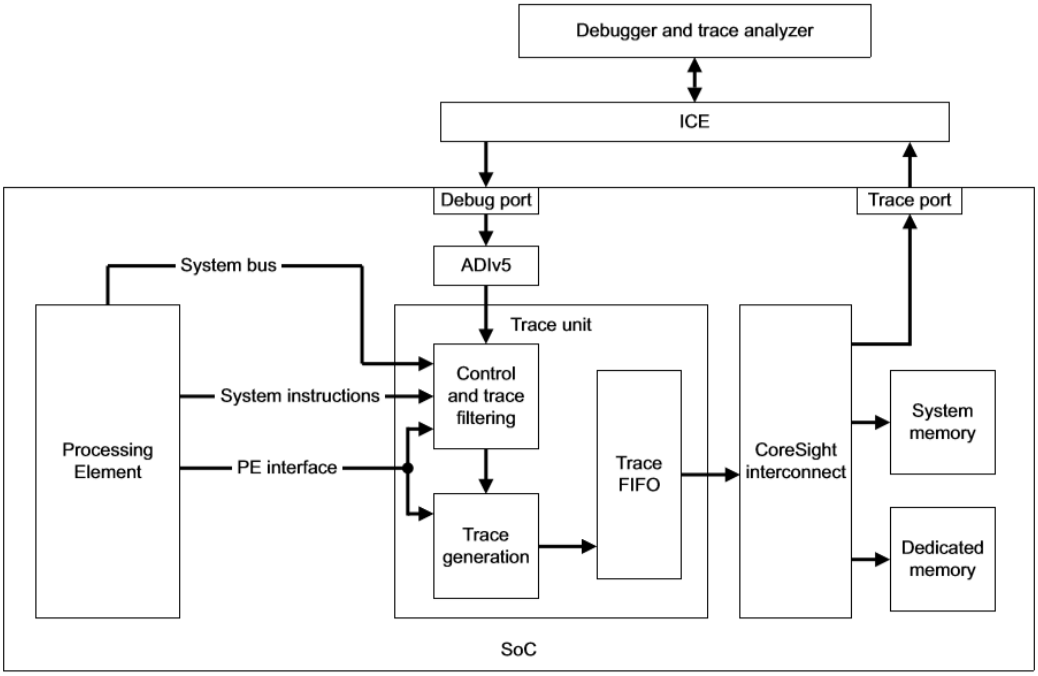


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

Embedded Trace Macrocell architecture

The processor implements the ETMv4 architecture. See the *ARM® Embedded Trace Macrocell Architecture Specification, ETMv4*.

Source: ARM Cortex-A72 MPCore Processor manual downloaded from

http://infocenter.arm.com/help/topic/com.arm.doc.100095_0001_02_en/cortex_a72_mpcore_trm_100095_0001_02_en.pdf

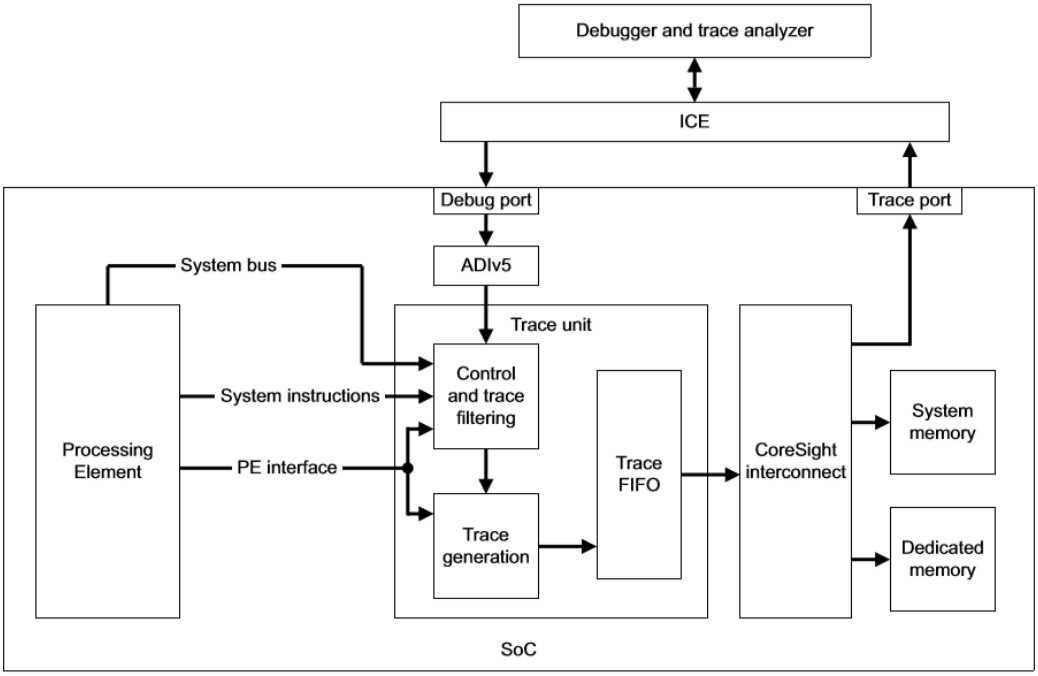


Figure 1-1 Example SoC with a trace unit

Source: ARM Embedded Trace Macrocell Architecture Specification downloaded from

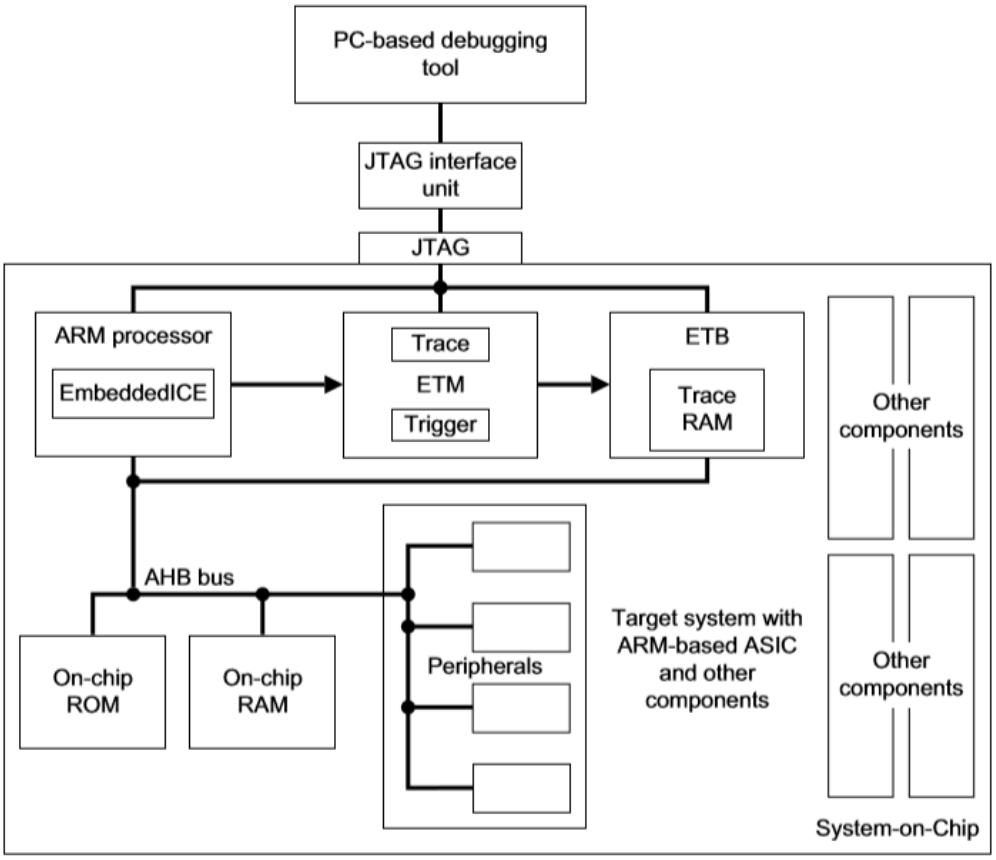
https://static.docs.arm.com/ihi0064/d/IHI0064D_etm_v4_architecture_spec.pdf

About the ETM

The ETM is a CoreSight™ component designed for use with the CoreSight Design Kit. CoreSight is the ARM extensible, system-wide debug and trace architecture. The Cortex-A8 processor implements the ETM architecture v3.3.

Source: ARM Cortex-A8 Technical Reference Manual downloaded from

https://static.docs.arm.com/ddi0344/k/DDI0344K_cortex_a8_r3p2_trm.pdf



Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

About controlling tracing

You control tracing in two ways:

Triggering Triggering controls when the collection of the trace data occurs. Setting a trigger enables you to focus trace collection around your region of interest.

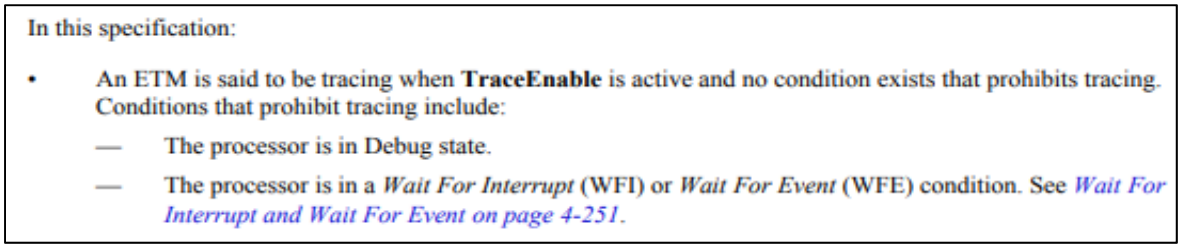
Filtering Filtering controls the type of trace information that is collected. It is important to optimize usage of the trace port bandwidth, especially when a narrow trace port is used. Filtering the trace serves two purposes:

- It prevents overflow of the internal FIFO by minimizing the number of data transfers traced. This is especially important when the FIFO is small or the trace port is narrow.
- It limits the amount of trace stored by the *trace capture device* (TCD), for example a TPA or an on-chip trace buffer. This enables more useful information to be stored around the trigger.

You can filter the instruction trace or the data trace as follows:

- Filter the instruction trace by enabling and disabling trace generation. This is the **TraceEnable** function.
- Filter the data trace by indicating the specific data accesses that must be traced. This is the **ViewData** function.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf



In this specification:

- An ETM is said to be tracing when **TraceEnable** is active and no condition exists that prohibits tracing. Conditions that prohibit tracing include:
  - The processor is in Debug state.
  - The processor is in a *Wait For Interrupt* (WFI) or *Wait For Event* (WFE) condition. See *Wait For Interrupt and Wait For Event on page 4-251*.

Source: ARM Embedded Trace Macrocell ETMv1.0 to ETMv3.5 Architecture Specification downloaded from https://static.docs.arm.com/ihi0014/q/IHI0014.pdf

118. The service processor unit of the accused products includes a control unit configured to control the service processor unit, a memory, an analysis engine, and a bus interface.

119. The accused products include a multiplicity of probe lines configured to capture and propagate one or more of the one or more system operation signals from said logic blocks to the service processor unit.

120. Defendants have had knowledge of the '938 Patent at least as of the date when they were notified of the filing of this action.

121. On November 23, 2005, the great-great-great-grandparent of the '938 Patent (U.S. Patent No. 6,687,865) was cited by the Examiner during prosecution of U.S. Patent No. 7,567,892, which is assigned to Broadcom Corp. The Examiner in that prosecution explained that the great-great-great-grandparent of the '938 Patent was pertinent because "Dervisoglu et al. (U.S. Patent No. 6,687,865) discloses an on-chip service processor for testing and debugging of integrated circuits." Broadcom employees Geoff Barrett, Simon Christopher Dequin Clemow, and Andrew Jon Dawson, who are listed as inventors on U.S. Patent No. 7,567,892, Robert

Sokohl, Jeffrey S. Weaver, and others involved in the prosecution of the patent, have had knowledge of the '938 Patent well before this suit was filed.

122. On March 6, 2006, the great-great-great grandparent of the '938 Patent (U.S. Patent No. 6,687,865) was cited in an IDS during prosecution of U.S. Patent No. 7,533,315, which is assigned to MediaTek Inc. During that same prosecution, the Examiner also cited the great grandparent of the '938 Patent (U.S. Patent No. 7,080,301) on June 18, 2008. MediaTek employees I-Chieh Han and You-Ming Chiu, who are listed as inventors on U.S. Patent No. 7,533,315, Daniel R. McClure, and others involved in the prosecution of the patent, have had knowledge of the '938 Patent well before this suit was filed.

123. American Patents has been damaged as a result of the infringing conduct by Defendants alleged above. Thus, Defendants are liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

124. American Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '938 Patent.

ADDITIONAL ALLEGATIONS REGARDING INDIRECT INFRINGEMENT

125. Defendants have also indirectly infringed the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent by inducing others to directly infringe the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent. Defendants have induced the end-users, its customers, to directly infringe (literally and/or under the doctrine of equivalents) the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent by using the accused products. Defendants took active steps, directly and/or through contractual relationships with others, with the specific

intent to cause them to use the accused products in a manner that infringes one or more claims of the patents-in-suit, including, for example, Claim 5 of the '001 Patent, Claim 7 of the '371 Patent, Claim 1 of the '716 Patent, and Claim 1 of the '938 Patent. Such steps by Defendants included, among other things, advising or directing customers and end-users to use the accused products in an infringing manner; advertising and promoting the use of the accused products in an infringing manner; and/or distributing instructions that guide users to use the accused products in an infringing manner. Defendants are performing these steps, which constitute induced infringement, with the knowledge of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent and with the knowledge that the induced acts constitute infringement. Defendants were and are aware that the normal and customary use of the accused products by Defendants' customers would infringe the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent. Defendants' inducement is ongoing.

126. Defendants have also induced its affiliates, or third-party manufacturers, shippers, distributors, retailers, or other persons acting on its or its affiliates' behalf, to directly infringe (literally and/or under the doctrine of equivalents) the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent by importing, selling or offering to sell the accused products. Defendants took active steps, directly and/or through contractual relationships with others, with the specific intent to cause such persons to import, sell, or offer to sell the accused products in a manner that infringes one or more claims of the patents-in-suit, including, for example, Claim 5 of the '001 Patent, Claim 7 of the '371 Patent, Claim 1 of the '716 Patent, and Claim 1 of the '938 Patent. Such steps by Defendants included, among other things, making or selling the accused products outside of the United States for importation into or sale in the United States, or knowing that such importation or sale would occur; and directing, facilitating, or influencing its

affiliates, or third-party manufacturers, shippers, distributors, retailers, or other persons acting on its behalf, to import, sell, or offer to sell the accused products in an infringing manner. Defendants performed these steps, which constitute induced infringement, with the knowledge of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent and with the knowledge that the induced acts would constitute infringement. Defendants performed such steps in order to profit from the eventual sale of the accused products in the United States. Defendants' inducement is ongoing.

127. Defendants have also indirectly infringed by contributing to the infringement of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent. Defendants have contributed to the direct infringement of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent by the end-user of the accused products. The accused products have special features that are specially designed to be used in an infringing way and that have no substantial uses other than ones that infringe the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent, including, for example, Claim 5 of the '001 Patent, Claim 7 of the '371 Patent, Claim 1 of the '716 Patent, and Claim 1 of the '938 Patent. The special features include advanced on-chip service capabilities in a manner that infringes the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent. The special features constitute a material part of the invention of one or more of the claims of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent and are not staple articles of commerce suitable for substantial non-infringing use. Defendants' contributory infringement is ongoing.

128. Furthermore, Defendants have a policy or practice of not reviewing the patents of others (including instructing its employees to not review the patents of others), and thus has been willfully blind of American Patents' patent rights.

129. Defendants' actions are at least objectively reckless as to the risk of infringing valid patents and this objective risk was either known or should have been known by Defendants.

130. Defendants' direct and indirect infringement of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent is, has been, and continues to be willful, intentional, deliberate, and/or in conscious disregard of American Patents' rights under the patents.

131. American Patents has been damaged as a result of the infringing conduct by Defendants alleged above. Thus, Defendants are liable to American Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

JURY DEMAND

American Patents hereby requests a trial by jury on all issues so triable by right.

PRAYER FOR RELIEF

American Patents requests that the Court find in its favor and against Defendants, and that the Court grant American Patents the following relief:

a. Judgment that one or more claims of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent have been infringed, either literally and/or under the doctrine of equivalents, by Defendants and/or all others acting in concert therewith;

b. A permanent injunction enjoining Defendants and their officers, directors, agents, servants, affiliates, employees, divisions, branches, subsidiaries, parents, and all others acting in concert therewith from infringement of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent; or, in the alternative, an award of a reasonable ongoing royalty for future infringement of the '001 Patent, the '371 Patent, the '716 Patent, and the '938 Patent;

e. Judgment that Defendants account for and pay to American Patents all damages to

and costs incurred by American Patents because of Defendants' infringing activities and other conduct complained of herein, including an award of all increased damages to which American Patents is entitled under 35 U.S.C. § 284;

f. That American Patents be granted pre-judgment and post-judgment interest on the damages caused by Defendants' infringing activities and other conduct complained of herein;

g. That this Court declare this an exceptional case and award American Patents its reasonable attorney's fees and costs in accordance with 35 U.S.C. § 285; and

h. That American Patents be granted such other and further relief as the Court may deem just and proper under the circumstances.

Dated: November 14, 2018

Respectfully submitted,

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